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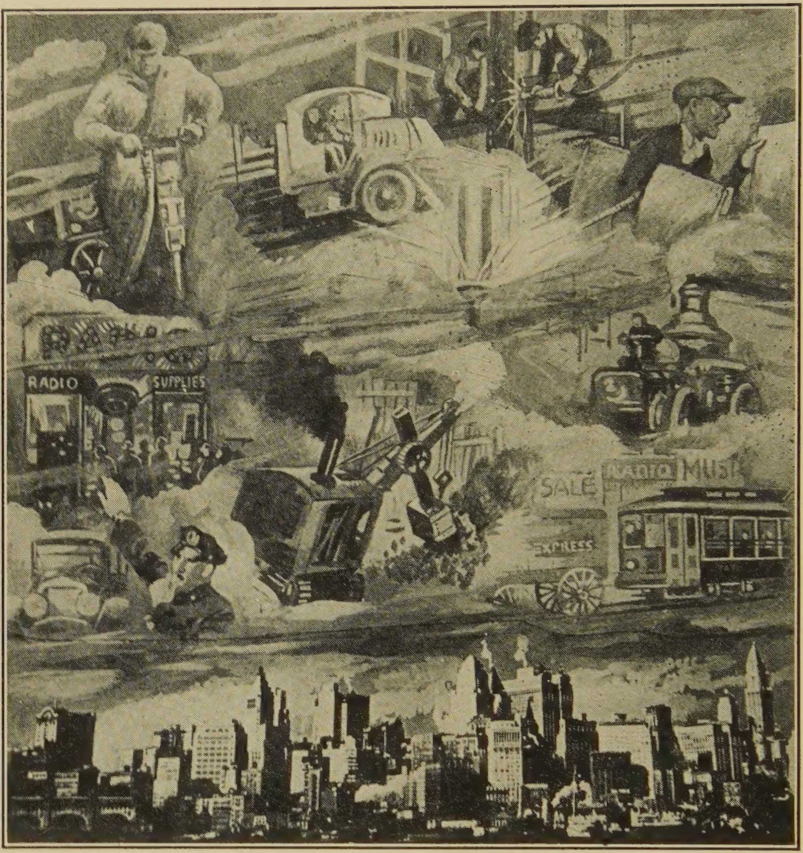
CITY NOISE


RADIO
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The truck and the motor and
trolley car and the elevated train

They make the weary city street
reverberate with pain. . . .

—JOYCE KILMER

CITY NOISE

The Report of the Commission Appointed by Dr.
Shirley W. Wynne, Commissioner of Health,
to Study Noise in New York City and to
Develop Means of Abating It.

Edited by

EDWARD F. BROWN
E. B. DENNIS, JR.
JEAN HENRY
G. EDWARD PENDRAY

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NOISE ABATEMENT COMMISSION
Department of Health, City of New York
1930

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1930

Noise Abatement Commission

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* Appointed August 15, 1930.

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*Appointed August 15, 1930.

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Commissioner of Health of New York City, Trustee of New York State Hospital for Incipient Tuberculosis; Chairman, Bellevue-Yorkville Health Demonstration; Medical Committee, Boy Scout Foundation; Fellow, New York Academy of Medicine, American Public Health Association, American Medical Association; President Association of Tuberculosis Clinics; Professor of Preventive Medicine, New York Polyclinic Medical School and Hospital; Chairman of the Department of Hospital Administration, School of Sociology, Fordham University; Consulting Physician, Willard Parker Hospital; Director, New York Tuberculosis and Health Association.

Edward F. Brown, Director

Special Deputy Commissioner of Health; Director of Diphtheria Prevention Commission.

E. B. Dennis, Jr., Executive Secretary

Acoustical Engineer, Johns-Manville Corporation.

THE cooperation of the following organizations has made possible the Noise Abatement Commission's many-sided attack on the complex problem of modern city noise: American Society of Mechanical Engineers' Sound Research Committee; American Telephone and Telegraph Company; automobile horn manufacturers; Bell Telephone Laboratories; Electrical Research Products, Inc.; Interborough Rapid Transit Corporation; Brooklyn-Manhattan Transit Corporation; General Motors Corporation; Johns-Manville Corporation; National Electric Light Association; Third Avenue Railway; the Civic Committee for the Abatement of Noise, made up of thirty outstanding civic organizations and chambers of commerce in the city; the Merchants' Association; the New York State Transit Commission; the Board of Transportation, the Police Department, and the Department of Sanitation, of the City of New York.

The following organizations and individuals have given financial support to the cause of making the city quieter and more healthful: Altman Foundation; Mrs. William H. Moore; A. S. Hutchins; Jeremiah Milbank; George Whitney; Mr. and Mrs. Thomas W. Lamont; W. R. K. Taylor; Mrs. A. J. Fox.

We gratefully acknowledge the work of Dr. R. H. Galt in conducting the noise survey of the city, of Dr. J. C. Steinberg in the automobile horn tests, and of Rexford S. Tucker in the measurement of indoor noise; the study of noise-proof construction in rapid transit, prepared by Robert Ridgway, Chief Engineer of the Board of Transportation; the valuable advice and editorial assistance given by Dr. E. E. Free, R. V. Parsons, and Dr. Charles F. Bolduan; the assistance of Judge W. Bruce Cobb in the preparation of the small fines amendment to the Charter; the practical aid given by Postmaster John J. Kiely; the prompt handling of noise complaints under the direction of Philip D. Hoyt, First Deputy Police Commissioner, and Dr. Alonzo Blauvelt, of the Department of Health; and the sincere cooperation of the metropolitan press in bringing the question of noise and its abatement before the public both by the printed word and through the use of lively cartoons.

History alone can write the full estimate of the pioneering work of the members of the Commission in developing ways and means to do away with the curse of city noise: Dr. Bernard Sachs, Dr. Foster Kennedy, Dr. Arthur B. Duel, Dr. Samuel J. Kopetzky, Dr. Frederick Tilney, and Dr. Alexis Carrel in bringing together available facts on the effects of noise and making original investigations to determine other facts; Dr. Harvey Fletcher, Dr. Arthur B. Duel, and Prof. A. H. Beyer in charting city noise sources, measuring noise levels, and analyzing these findings; Mr. Charles C. Burlingham, Dr. Samuel A. Brown, Mr. Alfred H. Swayne, Judge Joseph Eugene Corrigan, and Dr. William Schroeder, Jr. in drafting adequate laws against noise and in evolving efficient methods of enforcing such laws; Prof. A. H. Beyer, Mr. Charles C. Burlingham, and Mr. Lawson Purdy in research into quieter methods of construction and demolition and in the study of sound-absorbing construction for buildings, subways, and elevated railroads; Dr. Arthur B. Duel, Dr. Foster Kennedy, Dr. Frederick Tilney, and Dr. Bernard Sachs in the securing of funds to make the Commission's work possible.

EDWARD F. BROWN, *Director.*

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Foreword

EIGHT MONTHS *ago I appointed a Commission to study city noise and map out the means of abating it. This is the report of its work.*

It is the result of serious study and work in medicine, neurology, otology, law, law adminsitration, acoustics, engineering, construction, and the automotive industries. For the first time, men skilled in the many fields that touch upon the noise problem have worked together in an effort to understand it in its wide-reaching ramifications and to find ways of diminishing the clamor of our city.

They have discovered much that has heretofore been only suspected in regard to noise and much that was not known until the problem was spread out in its entirety. Upon this foundation of fact they have based their recommendations—the practical recommendations of men accustomed to solve complex problems by straightforward thinking.

The report is now published in clear, popular form so that all may read and understand how to do their part in eliminating noise—that annoying by-product of our machine-using age. The Noise Abatement Commission now shares with the six million dwellers in New York City the pioneering task of removing unnecessary noise from city life and, to that end, shares also its knowledge of conditions and its suggestions for remedies.

This volume is the record of the generous contribution of time and talents by the members of the Commission to their city. They *have labored with no hope of reward other than to make New York a peaceful, healthful place in which we can live.*

So far, aside from the progress made in providing measures for reducing specific noises, the Commission has concerned itself primarily with fact-finding, establishing a sound foundation on which noise abatement will be based. I have asked the Commission to continue its work until all its studies are completed and the city will have the benefit of its guidance and help. New York City is indeed fortunate that the Commission has consented to continue for an extended period until unnecessary city noise is abated.

Shirley Wynne.

Commissioner of Health.

CITY NOISE

The Noise Abatement Commission Reports to Dr. Shirley W. Wynne,

Commissioner of Health, City of New York

THE Noise Abatement Commission, appointed by you in October 1929 to study the complex noise situation in New York City with a view to finding ways and means of eliminating unnecessary noise and of determining the effect of noise in general on the inhabitants of a metropolitan center like our own, has virtually completed the first phase of the work in connection with its mission and is herewith submitting this report and recommendations together with a statement of certain definite steps that may be taken at once to abate the noise nuisance.

Some progress in practical noise abatement already has been made through the activities of the Commission. At a conference on river and harbor noise, attended by representatives of the principal steamship and railroad companies, the New York Tow Boat Exchange, federal and municipal officials and interested citizens, the problem of unnecessary whistling and other noises attendant upon traffic in the harbor was considered at length, and the cooperation of tugboat companies, steamship lines and others connected with shipping was pledged in the campaign to diminish the din from these sources.

The cooperation of officials in charge of fleets of trucks has also been obtained in decreasing the noise caused by promiscuous blowing of horns and warnings. Notable among the groups offering this cooperation is that of the United States Mail. The Commission received a letter from Postmaster John J. Kiely which stated that he has given instructions to all drivers of mail trucks to keep cut-outs closed and to use their warning signals only to prevent accidents.

Important aid in the campaign to reduce noise was also received from the Interborough Rapid Transit Company, which informed the Commission early in April that it was desirous of developing a turnstile that would not be as noisy as the existing types. Later in the same month the first "noiseless" turnstile installation was made at Grand Central Station. It was pronounced a success by officials of the company. At present, the company is installing this proved type of silencer on all the turnstiles throughout the system.

Another type of turnstile has been tried out by the Brooklyn-Manhattan Transit Corporation and is now being installed on all of its mechanical turnstiles.

Good progress was also made in controlling and abating another noise nuisance often complained against: the radio loudspeaker. As a result of the recommendations of the Noise Abatement Commission changes were made in the Sanitary Code and the Code of Ordinances that permit the Health Commissioner and the police to control the indiscriminate use of loudspeakers. The Sanitary Code amendment prohibits the operation of any sound producing device which will disturb the quiet or repose of persons in the vicinity, and the amendment to the Code of Ordinances forbids the use of loudspeakers or other sound amplifying devices in any public street or place without a permit from the Police Commissioner, or in any case within 250 feet of a school, court house, church or hospital during the hours when these institutions are in use.

In addition to these definite steps, interest in the problem of noise in general has been aroused among engineers and technical men toward the production of less noisy machinery and vehicles, and we have gained the interest and cooperation of newspapers, magazines and other avenues of publicity. Through these channels a general public realization of the costliness, danger to health, and needlessness of increasing city noise has been brought about.

These are matters, however, that will be taken up in greater detail later in this report, and may be considered here in the light of by-products of the Commission's early work. As the first Noise Abatement Commission ever appointed in the United States, and probably the first official body of its kind ever to undertake a thorough scientific analysis of the noise problem anywhere, the members at their first meeting found that the field was practically unexplored and that an immense amount of research and investigation would have to be entered into before thorough going and workable remedies could be suggested.

We had immediately at hand almost nothing to guide us in formulating the work except the suggestions contained in your letter to the members of the Commission, in which you said:

> The City is indebted to you for consenting to serve on the Noise Commission. I hope it will be possible for the Commission to meet without undue delay and commence its labors. You shall be advised of the organization meeting which will take place within the next fortnight.
>
> I enclose the complete personnel of the Commission. While desiring to limit the Commission to a small group of people eminent in some field associated with problems of noise, I leave to you the question of additional names.
>
> The city can well congratulate itself that the complex noise situation is in the hands of such distinguished specialists in whom the public has an abiding confidence.
>
> All the facilities of the Health Department will be at your hand for whatever aid they can afford you in the solution of the questions with which you will deal.
>
> May I suggest the following divisions into which your work might reasonably fall, although I do not desire to bind you by any of these suggestions.
>
> 1. What is immediately possible under the existing ordinances and laws for the alleviation of the noise nuisance?
>
> It seems to me there are numerous abuses of the characteristic good nature and patience of the New Yorker which might be stopped without further ado. I have in mind such noises as the use of loudspeakers outside shops, and in homes; screeching of brakes; the unreasonable playing of musical instruments in homes at unreasonable hours; the abuse of automobile klaxons; the use of muffler cut-outs on automobiles and motor boats; noises from milk cans, ash cans, etc.; riveting work after a reasonable hour at night; turnstiles in subways, etc.
>
> If you will formulate reasonable rules for the government of these media which are subject to our present laws I will see that they are vigorously enforced so far as the Health Department is concerned.
>
> 2. We need a complete classification of noises; a tabulation of intensity geographically arranged; some scientific measurements of

> principal city noises, together with specific recommendations as to their control or elimination.
>
> 3. We need a scientific statement of the effect of noise on the human being.
>
> 4. We should have some scientific measurements of certain types of noises; and recommendations as to what constitutes the border line of reasonable inevitable noise and unreasonable noise.
>
> 5. What can be done with respect to sound-absorbing construction in buildings?
>
> 6. What experience is there in any part of the world which we may use as a basis for the elimination of unnecessary noise?
>
> 7. What additional laws, if any, are needed to govern the noise situation in New York?
>
> Other fields of fruitful research will suggest themselves to you. Some of these studies will entail laborious research, and the results may not be available immediately.
>
> I trust that you will direct your Commission in such a way that the noise-ridden public may derive the benefits of your recommendations as they form themselves into practical operating programs for us to carry out.
>
> I have the pledge of some of the best laboratory facilities in the country, if not in the world, which will be placed at our disposal for scientific phases of this work.
>
> The whole country will watch your work, as you constitute the first official Noise Commission in the United States. While no reasonable person will expect that the work of your Commission will result in the immediate and complete elimination of all noises, I am confident that whatever the fruits of your labors, they will go a great distance to making the City of New York a healthier and more tranquil place in which to live and work.

It was our understanding that this Commission was appointed by you as a result of the great number of complaints against the noise nuisance which had come to your attention as Commissioner of Health. As head of the Department of Health it was your duty to administer the regulations pertaining to noise which make up part of the Sanitary Code. Upon examination of these provisions you had found them antiquated, inadequate, and of such a nature as to be of little use in combating the mounting roar and crash of traffic, building, manufacture and sundry other noises which have accompanied the growth of the city.

It had come to your attention that there were in existence few studies relating to the effect of noise on human beings or the control and abatement of unnecessary noise which might guide you adequately in formulating new regulations for the control of this nuisance. While there was a general belief, backed up in some instances by expert opinion, that excess noise produced a harmful strain upon the nervous systems and hearing of persons continually submitted to it, there had been virtually no comprehensive studies in the full effect of traffic and other city noises on city dwellers.

Likewise, the causes of noise had not been analysed. No scientific study had been made as to whether or not many common and harmful noises might be eliminated. It was your feeling that research in these matters must be gone into in a modern way, as a problem in human and mechanical engineering, using all the apparatus of science that could be turned to account in the investigation.

The Noise Problem an Old One

City noises and the annoyances caused by them are by no means phenomena of our own age. Ever since men began to gather in large cities this matter has been recurrently considered by philosophers and administrators.

There is evidence that definite steps to abate noise were taken by the Greeks several centuries before the Christian era. We know that the cultured Greeks of Sybaris, who are reputed to have been more than usually sensitive to discomfort, took some thought in the matter.

Professor Henry J. Spooner, in an article published in the *Guildhouse Monthly,* London, November, 1929, called attention to the fact that this city, founded in 720 B. C. in Southern Italy, became great and wealthy, perhaps in part because of the regulations enforced by the authorities prohibiting industrial noises in residential areas and providing for zoning the city.

The Romans, who prided themselves at the time on their hardihood, sneered at these sensible regulations as signs of effeminacy and invented the tale about a Sybarite who could not sleep because a petal was crumpled in his bed of rose leaves.

Professor Spooner noted that in more recent times noise had been the cause of much mental distress among persons whose work depended in great part upon the use of their brains. "Carlyle dreaded the sound of a cock-crow, and had a sound-proof room made to work in. Schopenhauer, the famous German philosopher was tortured by the crack of a carter's whip, and believed that 'noise is the true murderer of thought.' Herbert Spencer, the great thinker, was so much affected by noise that he used to plug his ears with wool. He often said that 'you might gauge a man's intellectual capacity by the degree of his intolerance of unnecessary noises.' "

Mark Twain was another who found the noise of the city constantly annoying. The late Joseph Pulitzer added his voice to the rising chorus of protest against what many thinkers have come to regard as a menace to peace, contentment, health, and effective work. The noise of cities has become axiomatic. Thousands of persons have learned to expect it as one of the necessary discomforts of gregarious living. They bear it under protest, and not without harm to their nervous systems, their hearing and their mental processes.

Attempts at Abatement in Europe

Despite the growing pressure of noise throughout the period when cities increased in size and industry added its din to the clatter of traffic, there appears to have been no attempt either here or abroad to regulate or diminish unnecessary noise until quite recent times. Indications are that the problem has been recognized as one that would ultimately require solution since the beginning of the Industrial Revolution in Europe. Despite this recognition little or nothing was done. It may be that laxity with regard to noise regulation abroad was due to the *laissez faire* philosophies that were dominant throughout the early period of industrial growth. European cities, moreover, have never as a rule been subjected to the terrific increase in necessary and unnecessary noises that have become a part of the daily lives of urban dwellers in America.

This is particularly true, for instance, in the case of radios and loudspeakers. A report on the noise situation in London prepared for the Commission shows that very few shops use radio sets for advertising purposes. There is consequently no outpouring of radio programs into the streets day or night. The use of radio sets with harsh or blatant loudspeakers apparently is not so common in homes in London as in New York. Relatively few complaints from citizens about the radios of their neighbors have come to the authorities there.

The various noises arising from building construction have also been less annoying in Europe. As a rule buildings are smaller, requiring less foundation work and steel construction. The erection of structures goes on at a less furious pace, and in general the nerves of residents of London, Paris, Berlin and other large centers abroad are spared much of the racket that makes up an important part of the noise problem in this country.

The noise from buses, trucks, trams and private automobiles has caused considerable concern, however. Recently a "Conference on Road Traffic Noises and Priority of Traffic at Cross Roads," under the chairmanship of Sir Henry P. Maybury, was called in England at the instance of the Rt. Hon. Wilfred Ashley, M. P., Minister of Transport, to study the several problems arising from traffic noise and rights of way. It was the intention of the conference to offer suggestions as to how these problems might be made the subject of regulation.

Sir Henry Maybury, in his report, asserted that "a regulation should be made under the Motor Car Acts to deal with excessive and avoidable noise from motor vehicles which are badly constructed, badly loaded or in a faulty condition". He suggested a regulation drafted upon the following lines:

> "No person shall use or permit to be used on any highway any motor car—
>
> (I) which, or any part or accessory of which, or
>
> (II) the load of which
> creates any excessive noise, and for the purpose of these Regulations any noise shall be deemed to be an excessive noise if it is caused either directly or indirectly by—

Photograph by Hal Steffen

Heavy street traffic and elevated trains produce a noise level of 80 decibels

(I) the faulty construction, condition, lack of repair or adjustment of the motor car, or any part or accessory thereof: or

(II) the faulty packing or adjustment of the load of such motor car; and such noise is in excess of the noise ordinarily created by motor cars of similar class. Provided that it shall be a good defence to proceedings taken under this Regulation—

(a) to prove that the noise or the continuance of the noise in respect of which the proceedings are taken was due to some temporary or accidental cause and could not have been prevented by the exercise of due diligence and care on the part of the owner or driver of the motor car; and

(b) in the case of proceedings against the driver or person in charge of a motor car to prove that the noise arose through the negligence or fault of some other person whose duty it was to keep the motor car in proper condition or in a proper state of repair or adjustment, or properly to pack or adjust the load thereof, as the case may be."

The matter of horns and warning signals was considered at length by a subcommittee of the conference. Inquiry was made as to the types of horns in common use and the practicability of framing a definition which would serve to distinguish those which have a low and pleasing note from those which have a strident and irritating one. It was learned that, in a general way, all horns fall into these three groups: (1) Wind blown (either by hand or fan), (2) Electric motor driven, (3) Electric buzzer type.

But after further investigation the committee reported that these groups do not afford a basis for regulation, since it appears possible to make horns of any of these kinds which are either objectionable or melodious.

Regulation Found Difficult

The conference was unable to formulate any regulation therefor, that could control the nature of the horns used. It contented itself for the time being with suggesting a regulation forbidding the blowing of horns or sounding of audible warnings on cars or trucks not in motion, except when such use was necessary on grounds of safety.

The conference decided that the noise from traffic horns becomes unnecessarily annoying when the sounds are of an unduly strident nature or when the blower indulges in unnecessary or excessive use, particularly at night during normal sleeping hours. The possibility of establishing "zones of silence" in inhabited areas was explored, but, upon meeting uncompromising opposition from motoring organizations and after a consideration of the difficult administration problems involved, the proposal was abandoned.

It is interesting to note, in connection with the move of the Interborough Rapid Transit Company here to silence its turnstiles, that the Underground Company in London is now considering the reduction of noise in its tubes and is conducting experiments with that end in view.

Noise in Paris

A report prepared for the Commission showed that in Paris, as in London, the work of noise abatement had been confined to the noises generated by traffic. For many years the honking of horns on automobiles had been a source of complaint, both because of the peculiar quality of the warning signals used and because of the habit formed by French drivers of blowing the horn frequently, in sharp, short blasts.

After a consideration of the matter the Prefect of Police concluded that it would be too great a step to prohibit the use of horns entirely, and contented himself for the time being with making their use unlawful after midnight. It has since been reported by officials that this move has had a good effect on the entire noise situation. Drivers found that they could operate as safely without warnings as with them, and have consequently diminished the amount of horn-blowing in the daytime. It is true that there is still a great deal of horn noise in the Paris streets, but the general level is appreciably less than two years ago.

The Paris police, in making their noise survey preliminary to regulating the use of warning signals, learned that much horn-blowing was made necessary by the jay-walking habits of pedestrians. An educational campaign to reduce this feature of the traffic problem was instituted and as a rule Paris pedestrians are now better behaved in this respect than before, and are by far less troublesome than in New York where the darting of pedestrians across the streets against the lights leads to many accidents and is no doubt the cause of a great deal of unnecessary horn blowing.

Germans Warned to Protect Their Ears

In Germany the chief contributions in the campaign have been made against industrial noise. The Deutsche Gesellschaft fuer Gewerbehygiene (German Society of Industrial Hygiene) has formed a committee for studying and combating the noise attendant upon industry and has published and distributed a pamphlet on the cause and prevention of impaired hearing and on industrial noise.

According to this pamphlet[1], we learn:

"1. Noise can impair hearing by its intensity as well as by its duration; noise is transmitted not only through the air but also through the walls and floors of the working room. A single strong sound impression, such as a whistle, explosion or stroke, is especially injurious if it occurs suddenly or unexpectedly.

"2. The noise injures the most sensitive and vital parts of the organ of hearing; namely, the auditory nerve endings in the cochlea.

"3. Not every human ear is injured by loud continual industrial noise. The greater the power of resistance of the organism, and the healthier the organ of hearing, the less harmful is the effect of noise.

"4. An injury of the ear that is caused by a sudden and extremely loud sound (whistle, detonation) is noticed immediately by the injured person. A sensation of pressure is noticed, a ringing sound and earache develop; a strong blast of air sometimes causes bleeding and discharge of fluid from the ear. Impairment of hearing caused by continuous, moderate occupational noise develops gradually and is at first hardly noticed. In the beginning, many workers do not feel the influence of noise in the work-room. Examination by an ear specialist often reveals the impairment of hearing in such persons who are not aware of their injury."

---

[1] Foreign Letter (Berlin), *Jour. Am. Med. Assn.,* June 22, 1929, Vol. 92, p. 2119.

The pamphlet contains directions for the care of the ears, warning that they must be protected from extreme industrial noises with plugs of gauze saturated with petrolatum or wax. Apprentices and young workers were urged, before taking up work in a noisy plant, to have their ears examined by a specialist, and to have this examination repeated from time to time during the period of employment to ascertain if any impairment of hearing was being produced.

The German Committee asserted that "endeavors that strive to limit industrial noise should be promoted and supported. They include the proper distribution of machines, and suitable contrivances for the suppression of noise."

What Had Been Done in America

The increasing prevalence of noise in the daily life of every urban dweller has for some time been a matter for discussion and in some instances concern in this country. It had already drawn the attention of scientific men before the appointment of the Commission. Several valuable studies, particularly with regard to the effect of noise on living organisms, had been made.

Probably the most complete survey of the noise situation in New York up to the present was made under the auspices of the *Forum Magazine* in 1926-1928. This work was done under the direction of Dr. E. E. Free. The results were summarized in two articles appearing in the issues of the *Forum* for February, 1926, and March, 1928. (A copy of the second of these articles is included in full elsewhere in this report.)

Dr. Free described the principal sources of noise in New York, and at the end made some definite recommendations as to the best method of eliminating them. Laws, he suggested, might well be enacted to control important sources of unnecessary noise, somewhat as follows:

> "1. The owner of any automobile or truck, street car, or other vehicle found, on inspection, to be emitting unnecessary noise because of loose parts or bad adjustment shall be subject to heavy fine.

> "2. Loose joints in street rails, wide gaps at rail crossings, or other noise-producing breaks in the rails are prohibited.
>
> "3. No automobile horn or other warning signal shall be blown on streets equipped with traffic lights or provided with traffic officers (horn signals then being totally unnecessary) and horn signals on other locations shall be limited to a single sound lasting not over one second."

The National Safety Council has had a committee for two or three years on "The Elimination of Harmful Noise." Following a series of preliminary surveys the committee narrowed its scope in 1929, and changed its name to the "Committee on the Relation of Noise to Accidents." The new title outlines the scope of the work undertaken by this group, of which Dr. H. Clyde Snook of New York was chairman, and through the investigation of several eminent specialists in medicine, psychology and allied sciences, important contributions were made to our fund of knowledge with regard to the relation of noise to human reactions. It was the general consensus of the committee that noise is a direct contributing factor in accidents, both street and industrial, but a great deal of research is still to be made in this direction.

Tackling another angle of the complex noise problem, a program of research in acoustics has been undertaken by a committee appointed by the American Society of Mechanical Engineers. A part of its program as so far outlined is to undertake research to standardize the methods of measuring noise so that the noisiness of a machine may be put in definite terms in the specifications for its manufacture. The committee will also, it is understood, make some specific recommendations on the problem of preventing unnecessary noise in machinery.

A joint committee of the American Telephone and Telegraph Company and the National Electric Light Association has also been working on the problem taking up particularly noises that interfere with telephone conversation. Since these arise not only in the operation of the telephone plant but also in sources near the telephone station, the findings of this committee were considered important aids in the studies undertaken by the Noise Abatement Commission.

Finally, a number of individual researches particularly on the effect of noise on organisms have been carried on in this country.

Professor John J. B. Morgan, of Northwestern University, had made a number of investigations using the electrocardiograph, and had also conducted a research on the response of infants to a number of relatively pure tones.

Professor F. C. Dockeray, of Ohio Wesleyan University, has undertaken a study of the relation between noise and the output of human work.

At Colgate University, Dr. Donald A. Laird has conducted a series of important studies on the effects of noise, using infants, white rats, and trained subjects in various tests to determine the relation of noise to growth, annoyance, and sleep.

Dr. A. T. Poffenberger, of Columbia University, has had under development for some time a laboratory for measuring the effects of noise on metabolism, and preliminary results indicate that his work may be of extreme importance in determining the effect of noise upon individuals over considerable periods.

These individual studies, nearly all as yet incomplete, offer convincing proof that noise is a factor in city life that is undoubtedly disturbing, injurious to physical and mental well-being, and for the greater part dangerous and unnecessary. This brief outline of the results may be supplemented by reference to other portions of this report, where several detailed analyses have been included. The field of noise research, it is apparent, has hardly been touched, despite the antiquity of the problem.

The Problem is Tackled

For flexibility, to promote a speedy attack upon the problem over a wide front, the Commission was divided into five committees. These committees were: (1) on the Effect of Noise on Human Beings, (2) on Noise Measurement, (3) on Practical Application of Remedies, (4) on Building Code and Construction, and (5) on Finance.

The personnel of the committees was as follows:

1. Effect of Noise on Human Beings
    - Dr. Bernard Sachs—*Chairman*
    - Dr. Foster Kennedy

Dr. Arthur B. Duel
Dr. Samuel J. Kopetzky
Dr. Frederick Tilney
Dr. Alexis Carrel

2. Noise Measurement Survey
    Dr. Harvey Fletcher—*Chairman*
    Dr. Arthur B. Duel
    Prof. A. H. Beyer
3. Practical Application of Remedies
    Mr. Charles C. Burlingham—*Chairman*
    Dr. Samuel A. Brown
    Mr. Alfred H. Swayne
    Mr. Edward F. Brown
4. Building Code and Construction
    Prof. A. H. Beyer—*Chairman*
    Mr. Charles C. Burlingham
    Mr. Lawson Purdy
5. Finance
    Dr. Arthur B. Duel—*Chairman*
    Dr. Foster Kennedy
    Dr. Frederick Tilney

It was decided, in accordance with your suggestions, that a thorough study must be made of all phases of the noise problem. Nevertheless, we were convinced that the noisy condition of the city constituted a kind of emergency situation, calling for a speedy survey of the more preventable and diminishable noises in order that New Yorkers may as soon as possible begin to enjoy the fruits of the Commission's efforts.

Committee Program Outlined

Each committee was accordingly supplied by the Commission with a suggested outline of procedure, containing both immediate and ultimate objectives. The committee on Practical Application of Remedies was particularly asked to report on methods by which particularly annoying noises could speedily be controlled or abated. It was the opinion of the Commission that the work should be carried forward with all possible rapidity with an eye to practical results rather than theroretical discussion.

The committee on the Effect of Noise on Human Beings was asked to provide a scientific and authoritative statement of the effects of noise on persons continually subjected to them, making use of present sources and, if possible, carrying on independent research to arrive at a sound basis for the work of the Commission as related to the health of citizens of the city.

The committee on Noise Measurement was asked to undertake a survey, determining with the aid of instruments and otherwise the characteristics of noise in the aggregate and the contributions of specific noises. As a part of this survey the committee was to make a determination of the space and time distribution of noise and an analysis of its intensity and spectrum. It was asked to devise a set of reference measurements by which possible improvements could be evaluated.

The committee on Building Code and Construction was urged to co-operate with the engineering committee of the Merchants' Association and other bodies in proposed revisions of the Sanitary, Building and other codes, looking toward the possibility of reducing noise from elevated lines, subways, building construction, and other operations requiring the use of noisy tools or machines. The substitution of welding for riveting in the erection of steel structures was particularly recommended for study, as well as the silencing of the processes of wrecking, tearing up streets, and other operations in which pneumatic tools are used.

What About the Law?

A thorough study of existing New York laws and ordinances pertaining to the control of noise was recommended to the committee on Practical Application of Remedies, with a view to making such reclassifications, compilations, additions, or amendments as seemed necessary to aid enforcement or to bring under regulation any sources of unnecessary noise not now covered by the law.

The committee was asked to ascertain the power given to the Police or Health Departments by present regulations over such common sources of annoyance as inconsiderate use of radio loudspeakers for advertising purposes or in homes after a reasonable hour at night; indiscriminate employment of horns by drivers of automobiles, trucks and buses; muffler cut-outs; hard tires on heavy vehicles; unnecessary noises produced by the delivery of coal, milk, and other materials, and the collection of ashes and garbage; locomotive bells, whistles, or sirens, Fire Department and ambulance sirens, and noisy factories in or adjacent to residential districts.

This committee was also asked to report as quickly as possible why the laws regulating such noises are not enforced, and to suggest, in case they were found unenforceable, such changes as would bring them to bear in a practical way in the abatement of noise which could not be controlled through the present activities of the Police and Health Departments.

The Doctors Look at Noise

Strong support for the opinion of the Commission that a state of emergency exists in New York as a result of the increase in noise is found in the preliminary report of the committee on the Effect of Noise on Human Beings.

This committee, after a study of data so far made available through research, declared that the continual pressure of strident sound to which New Yorkers are subjected tends to produce impairment of hearing, to induce harmful strain upon the nervous system leading to neurasthenic and psychasthenic states, to cause loss of efficiency of workers and thinkers, and finally to interfere so gravely with sound, refreshing sleep that rest is difficult and in some cases impossible.

"That noise is harmful," says the report, "is sufficiently evidenced by the feeling of annoyance it causes almost everyone, and also by the fact that in many cities and in different countries the effect of noise has been seriously considered.

"Thus, in London, Sir Robert Armstrong-Jones states that city dwellers are neurotic—that sleep is indispensable to the neurotic, who does the work of the world—and the most disturbing noises to sleep are unusual and sudden horns, exhausts, drills, vibrations, whistles, and milk can deliveries.

"The Noise Commission of London believes that preventable noise retards the efficiency of brain workers and to the other noises it adds that of barking dogs, street venders, careless milkmen, and whistling locomotives.

"It also believes that there is a difference between street and industrial noises. Street noises are more injurious because they are non-rhythmical—the body cannot become adjusted to them, and they create tensions generating angry emotions, thereby adding to fatigue.

"It further believes that neurosis may be attributed to noises just as in the case of shell shock."

Noise Destroys Efficiency

The committee reported the interesting experiments conducted by Dr. John J. B. Morgan, of Northwestern University, in determining the effect of noise on mental efficiency. He set fifty subjects at work reading a paragraph. When a noise was introduced there was an increased effort on the part of the subjects in an attempt to keep their minds on their work. Dr. Morgan found that the increased effort caused an increase in breathing, while at the same time the speed of the readers decreased.

A similar effect was noticed in subejcts at work on typewriters. When a noise was introduced and the speed and accuracy of the work compared with that done in silence, it was found that the keys were struck with greater force during the noise, indicating that such processes carried on under the pressure of constant auditory disturbance produce greater fatigue and cause a larger output of energy for the same result. Dr. Morgan summarized his findings in these and other tests, according to the committee's report, by saying that overcoming noise while working requires extra effort.

The committee found that Professor A. T. Poffenberger, of Columbia University, who is making a valuable study of noise in relation to metabolism, believed that Professor Morgan had judged the effects too leniently, forgetting that the full ill effects do not show themselves immediately because people never work at their full capacity. The necessity of putting forth extra effort to overcome noise creates a continual strain on the nervous system which must ultimately show itself in reduced capacity for sustained work, clear thinking, and energetic action——the mainstays of civilized life.

Does Noise Cause Deafness?

As to the matter of deafness caused by noise, the committee noted that the structure of the ear makes it continuously adaptable provided these sounds merge and maintain a more or less uniform level. In traffic and many other city noises this is not the case. Consequently the portion of the ear which controls adaptation gets no rest.

After a time the muscles of accommodation, wearied by continual efforts to adjust the hearing to the various thumps, rattles, blasts, and hoots of sound which punctuate the undertone of street noise fail to react. This lack of function leaves a breach in the protection of the ear, opening the way for occupational deafness and causing additional fatigue and other harmful results.

"Wittmaack has proved," the report points out, "that some auditory organs are completely destroyed by prolonged exposure to loud noise, and he sees in this the positive development of deafness which often begins with an inability to distinctly recognize tones.

"Another British author is very certain that 'occupational deafness' is well known, and that as our cities become noisier, there will be more occupational deafness among printers, omnibus drivers, road breakers and traffic policemen.

"Here in New York this observation can easily be substantiated. Our automobile and taxi drivers are becoming hard of hearing and the same is known to be the case among boiler workers and other laborers or mechanics exposed to a constant riveting noise."

Aside from the effect which constant noise has upon many individuals and particularly upon their hearing, the committee found that the abatement of noise is imperative because it interferes with sleep.

"No argument is needed to the effect that every individual needs between six and nine hours of sleep. The majority is accustomed to take sleep during the night, and for that reason, at least, the house from eleven to seven should be entirely free of distressing noises."

Growing children, many invalids and all convalescent patients are in need of complete quiet during the day as well as the night. In addition to these, New York contains many night workers who must obtain their necessary rest during the daylight hours. These facts make it clear that a partial abatement of noise during the night will not fit the need of a city as large and diverse as this. The whole chorus of sound must be decreased at all hours.

With regard to schools, the committee reported that the noise of the streets interferes with attention and concentration to a marked degree, making the task of teachers and pupils appreciably more difficult and less efficient.

Noise Puts Pressure on the Brain

The committee, moved by its desire to achieve results in the briefest possible time, did not go deeply into the more theoretical psychological reactions to noise in preparing its preliminary report, since an estimate of the immediate and practical effects was desired as a basis for the further work of the Commission.

Dr. Foster Kennedy, chairman of the committee, undertook a series of investigations in the department of neurology at Bellevue Hospital to determine the physiological effect of various noises on the brain. In the wards at Bellevue he found many persons who in the past had required operations on the skull necessitating the removal of bone and the replacement of the scalp. Several patients of this type, otherwise in perfect health, were used in the tests.

It was possible to get an accurate written record of the pressure of the brain by placing a small drum containing a partial vacuum over the soft area of the head. This was painless to the subject. The drum registered all the vibrations in the brain lying beneath

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FREIGHT

Photograph by *Underwood & Underwood*

Horn-tooting was the basis of nearly ten per cent of the complaints received at the beginning of the survey. Unnecessary sounding of horns robs genuine warning signals of authority and adds to traffic confusion

it by communicating the vibrations to a fine recording needle that impinged on a moving strip of carbon-blackened paper.

The normal pulsations of the brain and its pressure were first recorded on the paper, and then the pulsations under the influence of noise. Paper bags, blown up and exploded, were used in one experiment and it was found that the noise of the explosion raised the brain pressure to four times the normal for seven seconds. Thereafter this pressure, though not remaining as high, did not come back to normal until thirty seconds had passed.

Some idea of what this means as compared with other powerful shocking agents in their action on the brain was gained by test experiments with morphine and nitroglycerine on the same subjects. These two drugs are known to raise the pressure of the brain more than any other drug, but it was found that sudden noise raised it more than either of these.

If this is the effect of the bursting of a paper bag upon a normal brain it is clear that the increase in brain pressure induced by the passing of an unmuffled motor truck must be terrific.

The effects of noise have been described by research workers as "emotional." Long before the emotions are actively disturbed however there are undoubtedly disturbances expressed in heightened pulse rates, increased blood pressure, irregularities in heart rhythm, and, most important of all, in the increase of pressure on the brain itself, as Dr. Kennedy's investigation showed. Emotion is only the end product of the process; the undoubted effect of constant noise is disturbance of the blood vessel apparatus and the increase in the degenerative processes of the heart and arteries.

Summing up its preliminary report, the committee on the Effect of Noise on Human Beings found that:

1. Hearing is apt to be impaired in those exposed to constant loud noises.

2. Noise interferes seriously with the efficiency of the worker. It lessens attention and makes concentration upon any task difficult.

3. In the attempt to overcome the effect of noise, great strain is put upon the nervous system, leading to neurasthenic and psychasthenic states, and necessitating frequent recuperation in the country to maintain mental efficiency and alertness.

Photograph by *Underwood and Underwood*

A noise that greets city dwellers at dawn.

4. Noise interferes seriously with sleep, even though in some cases it appears that the system is able to adjust itself so that wakefulness does not result.

5. It is well established that, in addition to these other evil effects, the normal development of infants and young children is seriously interfered with by constant loud noises.

The committee and the Commission believe that the work already done proves sufficiently what every worker in New York City already knows if he has thought about the matter—that the constant racket of traffic, construction, industry, and innumerable unnecessary noises added to it produces a profound depression upon the nervous system, reduces mental efficiency and makes for dullness and ill health, matters which may well concern the city in its efforts toward greater alertness and health among its citizens.

What Noises Annoy New Yorkers?

Concurrently with the work of the committee on the Effect of Noise on Human Beings the Commission undertook a canvass of residents of the city to learn the various types of noise that cause annoyance and the degree to which they effect the whole population. Preliminary questioning and analysis of complaints showed that the same noise does not annoy everyone; that some persons complained of sounds which others found innocuous and sometimes even pleasing; and that, in general, opinions on annoying noise depended more upon personal reaction than upon the nature of the noise.

It was believed by the Commission that the degree of annoyance produced by any noise was a fair measure of its harmfulness, and that some attempt should be made in a statistical way to learn what particular sources were most apt to provoke New Yorkers to protest.

Accordingly the Commission prepared a questionnaire on noise which was printed in all metropolitan newspapers. In form it was as follows:

NOISE ABATEMENT QUESTIONNAIRE

Use a soft pencil in filling out questionnaire. Under "Location" give the address of the source of the noises most annoying to you, and under "Hour of Day" state the time at which these noises are noticed by you.

SOURCE OF NOISE	LOCATION	HOUR OF DAY
Loud Speakers in Home - - - -	....	....
Automobile Horns - - - - - -	....	....
Trucks——Horse-Drawn - - -	....	....
Trucks——Motor - - - - - - -	....	....
Buses——Noisy Mechanism or Tires	....	....
Automobile Cut-Outs - - - -	....	....
Noisy Brakes on Automobiles - -	....	....
Riveting - - - - - - - - -	....	....
Pneumatic Drills on Streets - -	....	....
Pneumatic Drills on Excavations -	....	....
Loud Speakers Outside of Stores -	....	....
Airplanes - - - - - - - -	....	....
Noisy Parties - - - - - - -	....	....
Locomotive Whistles and Bells -	....	....
Tug and Steamship Whistles - -	....	....
Elevated Trains - - - - - -	....	....
Subway Trains - - - - - - -	....	....
Subway Turnstiles - - - - -	....	....
Street Cars - - - - - - - - -	....	....
Ash and Garbage Collections - -	....	....
Newsboys' Cries - - - - - -	....	....
Unmuffled Motorboats - - - -	....	....
Traffic Whistles - - - - - - -	....	....
Fire Department Sirens and Trucks	....	....
Milkmen - - - - - - - - -	....	....
Factories - - - - - - - - -	....	....

What ONE noise is MOST annoying? ....

If you have suggestions to offer, write a letter and attach it to your questionnaire.

Signed ....

Address ....

NOTE: Your name and address will not be used publicly in any way or at any time.

Mail this questionnaire to: NOISE ABATEMENT COMMISSION
505 Pearl Street, New York City

Complainants were asked to report the source of noises that annoyed them, to give the location and the hours, and finally to sign their names. Twenty-six common sources of noise were listed, with space provided for such additional noises as the complainant cared to write in.

Through the courtesy of New York newspapers these questionnaires were given wide publicity and were printed conspicuously for the convenience of persons who wished to participate in the survey. A total of 11,068 complaints against specific noises were received, many apparently from persons who had been seriously affected and who were unusually sensitive. The majority, as medical surveys have shown, become tolerant or "get used" to noises and pour out enormous reservoirs of energy in the continual effort of their unconscious adjustments. From people whose injuries from noises are thus below the threshold of consciousness few replies to our questionnaire were to be expected. It was probably therefore from the more than usually sensitive that the results of the survey came.

The Commission nevertheless believed that the distribution of complaints over the list of noise sources would serve as a valuable guide to its subsequent more scientific investigations. A careful analysis of noises by the committee on Noise Measurement subsequently indicated that this was true. By far the greater number of complaints received, for instance, were directed against motor trucks and automobile horns, these two sources accounting for nearly twenty per cent of the complaints recorded. Later analyses of street noise and city noise in general by scientific measuring apparatus showed that from these sources come most of the sharp, disturbing dissonances which wear on the nerves of city dwellers in everyday life.

Traffic, Transportation and Radio Noises Lead

The table proved of such value as an index to the relative annoyance generated by various noises that a complete tabulation is appended here, together with a second classification bringing together the various types of noises:

TABULATION OF NOISE COMPLAINTS—March 1, 1930

SOURCE	NUMBER	PERCENT
Trucks——Motor	1,125	10.16
Automobile Horns	1,087	9.81
Radios——Homes	774	7.00
Elevated Trains	731	6.62
Radios——Street & Stores	593	5.36
Automobile Brakes	583	5.27
Ash & Garbage Collections	572	5.17
Street Cars	570	5.16
Automobile Cut-Outs	504	4.55
Fire Department Sirens and Trucks	455	4.12
Noisy Parties and Entertainments	453	4.10
Milk and Ice Deliveries	451	4.07
Riveting	373	3.37
Subway Turnstiles	317	2.86
Buses	271	2.45
Trucks——Horse Drawn	268	2.41
Locomotive Whistles and Bells	238	2.15
Pneumatic Drills——Excavations	233	2.11
Tug and Steamship Whistles	223	2.01
Pneumatic Drills——Streets	213	1.93
Newsboys and Peddlers	212	1.91
Subway Trains	183	1.65
Dogs and Cats	140	1.26
Traffic Whistles	137	1.24
Factories	117	1.06
Airplanes	113	1.02
Motor Boats	66	0.59
Motorcycles	41	0.37
Restaurant Dishwashing	25	0.22
	11,068	100.00

CLASSIFICATION

SOURCE	NUMBER	PERCENT
TRAFFIC (Trucks, Automobile Horns, Cut-Outs, Brakes, Buses, Traffic Whistles, Motorcycles)	4,016	36.28
TRANSPORTATION (Elevated, Street Cars, Subway)	1,801	16.29
RADIOS (Homes, Streets & Stores)	1,367	12.34
COLLECTIONS & DELIVERIES (Ash, Garbage, Milk, Ice)	1,023	9.25
WHISTLES & BELLS (Fire Dept., Locomotives & Tugs & Steamships)	916	8.28
CONSTRUCTION (Riveting, Pneumatic Drills)	819	7.40
VOCAL, ETC. (Newsboys, Peddlers, Dogs, Cats, Noisy Parties)	805	7.27
OTHERS	321	2.89
	11,068	100.00

It will be observed that in this survey more than 36 per cent of all complaints were directed at traffic noises, while next in importance came transportation, with 1,801, or 16.29 per cent of the complaints, and radios with 1,367, or 12.34 per cent. The noises of construction, annoyances often mentioned by New Yorkers, received only 819 complaints, or 7.40 per cent, appreciably behind the annoyance caused by careless collections and deliveries of ashes, garbage, milk, and ice, against which were registered 1,023 complaints, or 9.25 per cent.

It must be noted, however, in order that there may be no confusion with regard to this tabulation, that the power of a noise to generate annoyance is not closely correlated with its intensity or "noisiness," but is determined by this factor in addition to the frequency of the occurrence and several other psychological factors.

There has not yet been worked out a satisfactory unit by which the annoyance-causing factor of noise can be measured.

The degree of annoyance seems to depend only in part upon the noise level and the frequency of occurrence. It is also affected by the character of the sound including perhaps its component frequencies and character, whether steady or intermittent—and whether or not it is commonly regarded as quite unnecessary. We are apt to be more annoyed, for instance, by the squeaking brakes of an automobile than by the more intense, but continuous roar of the subway.

Investigating Complaints

In many cases the filled-out questionnaires were accompanied by a letter serving as a formal complaint, and in other instances individuals would send in a letter of complaint rather than a questionnaire. From the date of publication of the questionnaire to the time this report was written these complaints have poured into the office of the Commission.

After the complaints have served their primary purpose—that of providing information in regard to the noises that are annoying to the residents of the city—they were forwarded to the proper city departments for investigation and action. In this the

Commission acted as a clearing house, and thus the proper handling of each complaint was assured.

The bulk of the complaints were handled by the Department of Health under the direction of Dr. Alonzo Blauvelt. The complaints ranged from the noise of radio, through noisy parties, barking dogs, ash and garbage collection by private companies, to the noises from milk wagons and pie trucks.

Traffic noise complaints were referred to the Police Department and received the personal attention of First Deputy Commissioner Hoyt. Other complaints were referred to the Department of Sanitation and the Transit Commission. In all cases the departments concerned cooperated with the Commission in a splendid manner and whenever possible conditions were corrected to eliminate or reduce the noise.

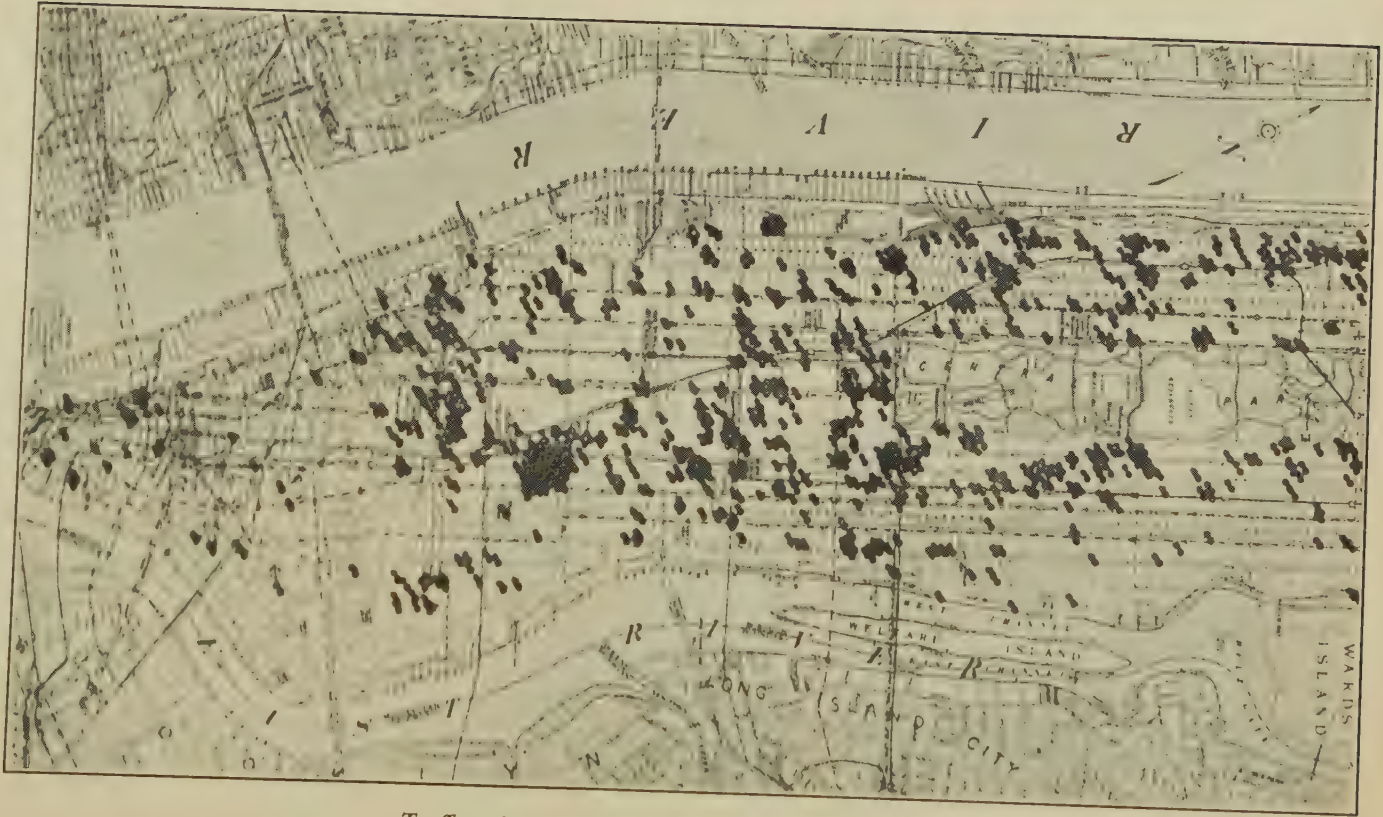
Science Undertakes the Measurement of Noise

Through the cooperation of private companies already well equipped with laboratories, apparatus, and trained technical experts, the Commission was able to undertake the first complete scientific survey and analysis of city noise ever attempted.

Arrangements were made whereby the Bell Telephone Laboratories furnished the Commission with the necessary apparatus and the services of engineers to operate in the field. The Johns-Manville Corporation placed at our disposal the services of additional acoustical engineers.

This valuable work would have been impossible without the cooperation of these two companies. They furnished trained men and apparatus worth thousands of dollars without cost to the Commission or the city. Subsequent analysis and experimentation was carried on in the Bell Telephone Laboratories, using the company's apparatus.

A truck was obtained from the Health Department and the noise measuring apparatus mounted therein to simplify the process of moving it about the city during the survey. An itinerary covering Manhattan, Brooklyn, the Bronx, and Queens was laid out in such a way that extremes of noisiness and quietness could be observed. The traveling noise laboratory began its work late


WARDS ISLAND
WELFARE ISLAND
LONG ISLAND CITY

Traffic noise as revealed in the November questionnaire in November 1929 manned by trained technical men and observers, keeping a complete record of all observations. In charge of the work was Dr. R. H. Galt of the Bell Telephone Laboratories. Assisting him were the following:

Bell Telephone Laboratories
A. Meyer
T. G. Castner
H. Kahl
L. Y. Lacy
A. W. Treptow
F. M. Carlisle
K. P. Seacord

Johns-Manville Corporation
J. H. Parkinson
C. Meyer
M. J. Lenhardt

Department of Health
Stewart M. MacGonigle
Conrad Scheppler

The traveling noise laboratory began its cruise of Greater New York in the square before the Department of Health Building, Center and Pearl Streets. The noise measuring devices carried were of two types: one that measured the deafening effect of noise, and another called a "noise meter," that picked up the noise directly through a microphone and registered its intensity on a dial.

The device to measure the deafening effect consisted essentially of a record, similar to that used in a phonograph, carrying three bands or ranges of tones of known intensity. These were reproduced on a turntable with an electrical pick-up. The observer heard the sound through an off-set receiver which permitted the street and other noises being measured to be heard at the same time.

The result was a test of the "masking effect" of noise at any given spot, determined by the intensity necessary to make a tone of known intensity just audible above the noise being measured. The difference between the intensity of the test tone and the intensity required for the tone to be heard in a quiet place is a measure of the amount of noise present. This test, while in some respects not as accurate as the direct meter test, since it depends upon the reactions of the human ear rather than upon the precise responses of electrical measurement devices, is valuable in many

OFFICIAL
MEASURING APPARATUS
NOISE
ABATEMENT COMMISSION

Photograph by *Bell Telephone Laboratories*

The noise measuring truck traveled over 500 miles in city streets, observing noise levels at 138 stations

ways. It serves both as a check on direct measurement and as a guide for determining the loudness necessary for such warning signals as automobile horns and police whistles.

The chief contributions of the traveling noise laboratory, however, came from the direct measurement of noise present at various places in the city, certain more complicated analyses of this noise, and a determination of its sources.

The unit of loudness used was the decibel. This has been described approximately as the smallest change which the ear can detect in the level of sound.

More accurately, the unit may be defined as a ratio of intensities. Thus, if the intensities of two sounds are in ratio 10 to 1, they differ by 10 decibels. If the intensities are in the ratio 10^2 to 1—that is 100 to 1—the sounds differ by 20 decibels. In general, the number of decibels measuring the difference between two sounds is ten times the common logarithm of the intensity ratio.

Reducing this to a matter of common experience, it may be said that a normal conversation, carried on at a distance of three feet, has a loudness of about 60 decibels. Since decibels do not measure absolute units of loudness, but a ratio of intensities, a small difference in the loudness as expressed in decibels means a tremendous difference in the intensities involved.

Some idea of what this means may be gained from the following table, in which the left-hand column represents decibels above the threshold of hearing, and the right-hand column the actual intensity above the threshold of hearing:

Decibels	*Intensity Above the Threshold*
10	10
20	100
30	1000
40	10,000
50	100,000
60	1,000,000
70	10,000,000
80	100,000,000
90	1,000,000,000
100	10,000,000,000

The table makes clear the difference between loudness, as measured by the ear (decibels) and intensity, as measured by electrical instruments. While loudness appears to the ear to increase by simple arithmetical progression, the intensity increases by logarithmic progression, leaping from ten to ten billion while the loudness goes from ten to one hundred.

This has been explained in such detail because it is important to understand that decibels do not measure absolute units, but are instead convenient symbols for expressing a ratio. The difference between 10 inches and 20 inches is the same, for instance, as that between 90 inches and 100 inches. But between sounds of 10 and 20 decibels above the threshold of hearing there is an intensity difference of 90, while the difference between sounds of 90 and 100 decibels is 9 billion.

The decibel was also the unit used in measurements of the "masking" effect of noise. Thus if the noise at a particular street corner is said to cause a masking of 60 decibels, this means that a sound which is just audible at that place is more intense by 60 decibels than a sound of the same type just audible in a quiet place.

In its report the committee on Noise Measurement expressed all noise levels and similar results simply as a certain number of decibels. This means decibels above the threshold of hearing, the scale beginning at the threshold as zero. Thus when the noise level at a place is given as 60 decibels, the intensity indicated is 10^6 times—that is, one million times—the least intensity the normal ear can hear.

Noise measurements were made at 138 stations in the city, of which 113 were in Manhattan, 8 in Brooklyn, 12 in the Bronx, and 5 in Queens. Ninety-seven were outdoor locations representing the widest possible range of noise conditions, from the quiet of remote residential streets to the din of main highways; an equally wide range of traffic conditions, from no traffic to 120 automobiles a minute; and a range of geographical conditions varying from the open terrain of the New York University campus to the canyons of lower Broadway.

Measurements were made near excavation and construction work, in a subway, beside elevated lines, on a bridge over the East River, on the pier and simultaneously in an office, while the whistle of a departing steamship was being blown, on the streets near two schools and two hospitals, in rooms of a hospital and of a place of business and on adjacent streets, on "Radio Row," and under other special conditions.

A total of about 10,000 observations were made out of doors, 7,500 of them indicating the aggregate effect of all sources of noise at the particular place and time without isolating specific sources of the noise. In about 2,500 cases not only was the general measurement recorded, but the source of the noise was also identified. In about 500 cases, for instance, the noise due to the motor truck was measured. The sound of a police whistle was measured about 50 times, an automobile horn, 50 times, speeding brakes, 16 times. Altogether the noise produced by each of about thirty such individual sources was recorded and measured.

At several stations the aggregate noise from many sources was subjected to a frequency analysis by means of band-pass filters. The frequency of a noise, which refers to the number of oscillations or "waves" in a given time, determines the pitch of the sound, as distinct from the loudness, or intensity. A frequency analysis was also made of the noise produced by each of several separate sources.

At most of the stations not only was the intensity of the noise measured, but its deafening effect in three different frequency regions as well.

All measurements were made between the hours of 9:30 A.M. and 5:30 P.M. except at three stations where noises were measured throughout a twenty-four hour period. These stations were Wall Street near William, Canal Street and Broadway, and 42d. Street near Eighth Avenue.

Interesting Facts About Noises

This undertaking, the results of which are dealt with more fully in the report of the committee on Noise Measurement included in another section, revealed that the loudest noises a New Yorker has to contend with are those of riveting and blasting.

The roar of explosives measured at a subway excavation in the Bronx registered 96 decibels. The noise of riveters, observed several times in various locations, averaged 97 decibels—a truly terrific intensity when one remembers that decibels measure an ascending scale. The clatter of riveting and the roar of subway blasting are thus nearly ten billion times as intense as the smallest sound that can be distinguished by the human ear.

Fortunately for the ears and nerves of listeners, these are extreme "instantaneous" noise levels, registered by the noise meter at the top of its swing. At most stations the instantaneous noise level in decibels was observed about four times a minute over a period of ten minutes, taking full account of several complete cycles of traffic. The arithmetical average of these measurements was then taken as a figure indicating the "average" noise level for the station, which is invariably somewhat lower, of course, than the highest instantaneous level and probably gives a truer picture of conditions as they affect the ear over a stated period.

What the intensity of average city noises means, even under this method of calculation, is made evident by results taken from the table prepared in the committee's preliminary report:

The blast of a steamship whistle averages 93 decibels, but it is exceeded by the average noise of a subway express as it passes a local station underground, which measures 94 decibels.

A steam operated pile driver sets up a racket equal to 87 decibels, and a subway local train, observed under-ground, clatters by with a noise equal to 88.5 decibels.

These sounds, it will be observed, have an intensity approximately one billion times the smallest sound that can be heard.

Coming down to the relatively quiet noises of the city, we find that police whistles vary from 74 to 82 decibels; that elevated trains running on an open structure vary from 81.5 decibels to a little louder than a subway local, or 89 decibels; and that a battery of five noisy subway turnstiles, collecting nickels during rush hour, set up a clatter equal to 83 decibels. This latter racket is greater by half a decibel than that of excavation machinery at work boring out the foundations of an old building in Manhattan.

The often mentioned loudspeaker, measured where it is at its noisiest in "Radio Row," sets up sounds equal to 79 decibels, which has an intensity about a hundred million times greater than the smallest distinguishable sound.

Among other proportionately "quiet" noises may be mentioned the exhaust of unmuffled motor trucks, at 77.5 decibels; subway noise as perceived on the street through the grating, at 77 decibels; a street car passing over a crossing in the tracks, which registered 76.5 decibels; squeaking automobile brakes and automobile horns, both registering an average of 71 decibels; and the regular, standard din of street traffic, which varies from 60 decibels in some locations to 80 decibels in others, or from a million to a hundred million times the intensity of sound at the threshold of hearing.

Curiously, it was found that in some congested parts of the city the noise level remains fairly constant throughout the twenty-four hours of the day. In fact, more variation was observed during a twenty minute period when the measurements were made over short intervals of five and ten seconds within that period than during the whole twenty-four hour period when the measurements were made over prolonged intervals of twenty minutes each. For example, the twenty minute averages taken at 48th Street near 8th Avenue varied from 53 to 63 decibels or only by 10 decibels during a twenty-four hour observation period, but the ten-second intervals showed a variation of more than 20 decibels.

Noise Varies with the Traffic

Observations made by the traveling noise laboratory permitted the experts in charge to draw several general conclusions with regard to the relation of traffic volume and noise.

It was found that, as would be expected, locations having the greatest volume of traffic had in general the greatest average noise levels. It was also found that the average noise level increases by 3 decibels when the number of vehicles per minute is doubled, indicating another logical result—that the physical intensity of the sound is directly proportional to the number of vehicles per minute.

Tests showed, however, that while this relation holds over a wide range of traffic volume, when the number of vehicles per minute is increased beyond fifty, the rate of increase in noise falls off.

This effect is due, it is believed, to the increasing street width involved, a factor which of course has a definite bearing on the volume of noise delivered at any specific spot.

Basing their calculations upon the results of these tests, acoustical engineers are now able to predict quantitively for any particular place the probable effect upon the average noise level that would result from a known change in the volume of composition of the traffic or in the width of the street.

A special test was run by the laboratory on the noise generated by elevated trains, in order to get some idea of the sound reduction which might follow the removal of an elevated from a street. The average noise was computed for several Manhattan stations near elevated lines, for two conditions: first, using all observations, and second, using all observations except those made when trains were passing.

It was found that under these conditions the average noise level was reduced by 3 decibels and the maximum noise level by 7 decibels when no trains were running. No account was taken, of course, of the possible effect of removing the elevated structure, which might, it is conceded, either increase or decrease this indicated quieting effect.

It has often been argued that a large portion of the quietness afforded by the removal of elevated trains would be offset by an increase in traffic. The survey found, however, that the average noise of street traffic varies from 60 to 80 decibels, while elevated trains create a noise measuring as high as 91 decibels; an indication, at least, that all of the gain would not be swallowed up by increased street noise.

Other noise situations specially measured included an observation of the noise produced by a steamship whistle blown at the time of departure of a vessel from a dock in the Hudson River.

With the microphone located on the pier at a distance of 115 feet from the whistle, a maximum level of 94 decibels was measured, and the whistle created an average sound of 93 decibels. Simultaneously an observation was made of the noise level in a tenth story room with window open looking directly out toward the steamship, 1450 feet distant. The noise level in the room was from 59 to 65 decibels, and other observations made it clear that the noise level in a room due to a loud steamship whistle a quarter of a mile away may rise as high as 70 to 75 decibels.

At these levels conversation is difficult, study or concentration virtually impossible, and normal sleep almost out of the question.

Noise Within Buildings

A survey of room noises was made in the months of January to April 1929 by the joint subcommittee on Development and

Research of the American Telephone and Telegraph Company and the National Electric Light Association who have made available to the Noise Survey Committee the results of their survey. The report is given in full under Noise Measurement.

Measurements of room noise were made in residences, offices, factories, stores, and public buildings. While the survey was carried on primarily in New York City, supplemental measurements were made in cities and towns in the neighborhood of Greater New York.

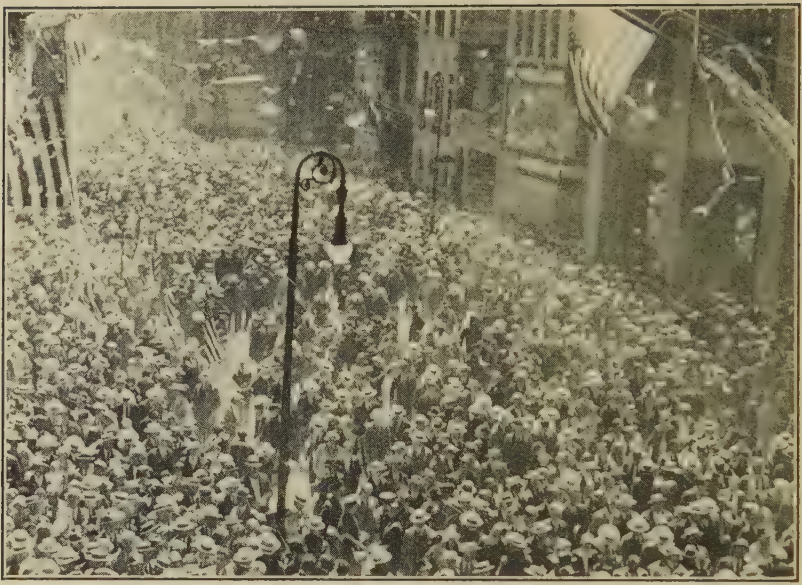
It was found that the average noise level for residences was 31 decibels, while the minimum level encountered was 22 decibels and the maximum 45. In the case of the residential measurements the chief contributing source of the noise was indoors in a majority of the rooms where the noise level was measured. Of the highest eight noises, half were due chiefly to indoor sources and half to outdoor sources.

In the non-residential locations the average noise level measured was 51 decibels, with a minimum of 32 and a maximum of 72, which occurred in a machine shop. As in the residential locations the chief contributing source of noise in most cases was indoors, with the highest noises coming from machines, either in factories or in offices.

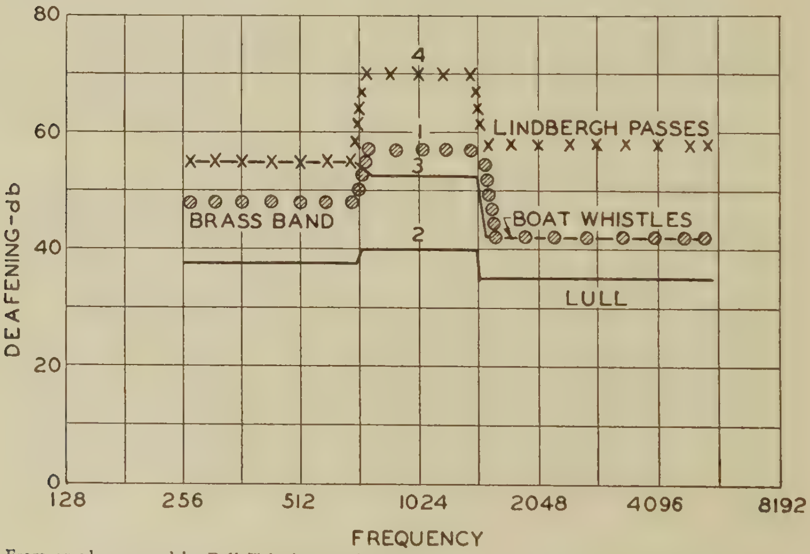
The average noise level for the residences where the measurements were made was 20 decibels lower than for the non-residential rooms, and the range of noise levels was less for the residential rooms. The highest residential noise level was just below the lowest street noise level, while the levels in the non-residential buildings ranged from midway of the residences to well above midway of the street noises. The comparison shows that residence noises range from 22 decibels to 45, the street levels from 47 to 80, and the non-residential indoor levels are spread over a range from 32 to 72 decibels.

The Deafening Effect

In measuring the "deafening effect" of city noises the engineers sought to learn how much the various levels of sound masked or deafened the normal ear. This test has nothing to do



Photograph by *Pacific & Atlantic Photos*



From graph prepared by Bell Telephone Laboratories

How noise piled on noise produces a deafening effect. The crowd gathered on lower Broadway to welcome Lindbergh could not count the decibels of surrounding sound, but each individual found he had to shout his conversation to his companions with the permanent deafness that may be produced by noise, as described in the medical report. It is an auditory measure of the loudness of noise as compared with a pure tone of known loudness. The term "deafening" used in this sense refers to the tendency of a noise to drown out or mask a tone of the same or lower degree of noisiness.

This phenomenon is often observed. For instance if two persons are under an elevated structure when no trains are passing their conversation may be carried on at normal loudness, but when a train passes overhead the additional noise drowns out the sound of their voices. It is then necessary to raise the voice to a loudness greater than that of the total street and overhead noise in order to be heard.

It has been noticed that sounds at certain frequencies are not as easily drowned out by traffic noise as others. Tests on the deafening effects of noises encountered, as measured by the tone apparatus described earlier, showed that the masking was greater in the middle frequencies (750 to 1,500 cycles) than in either the higher or lower ranges used.

The deafening effect in this band of frequencies in Central Park, near the south end of the Mall, was found to be about 48 decibels which means that a given tone of this frequency, to be heard at that spot, must have an intensity nearly a hundred thousand times that of the weakest audible tone. A conversation could be carried on easily there, since the average loudness of a conversation is about 60 decibels.

At Bowery and Canal Streets, under the elevated, the deafening effect was found to be as high as 67 decibels. A conversation to be heard there would have to be carried on at an intensity nearly ten million times greater than the smallest audible sound.

It was found that under normal traffic conditions a sound must have loudness of 50 to 55 decibels to be heard and in maximum traffic this loudness must be increased to 75 decibels. Comparing these figures with the noise level of a police whistle at 76 to 84 decibels, we find that very little diminution is allowable if the signal is to be heard 50 or 100 feet away.

It follows that if we are to decrease the noisiness of police whistles[1] and other necessary sounds, we must first reduce the level of the ocean of sound which threatens to drown them out even at their present high intensities.

The Lion's Roar

For comparison, the traveling noise laboratory made several observations of animal noises at the New York Zoological Gardens in Bronx Park. Allowing for reverberation in the animal houses, the outdoor level of the lion's roar, often used by writers to express the ultimate in terrific sounds, was found to be 87 decibels. Sounds emitted by a Siberian tiger measured only 79.5 decibels, and by a Bengal tiger, 75.5 decibels.

This test reveals certain facts which New Yorkers must be prepared to face. Although a roaring lion would be audible in our streets at a distance of twenty or thirty feet, there are many places where a tiger from Siberia or Bengal could roar or snarl indefinitely without attracting the auditory attention of passersby.

A Nickel's Worth of Quiet

It was pointed out earlier that a battery of five subway turnstiles, clattering away at high speed during rush hour, were found by the committee on Noise Measurement to contribute noise to the city's din at a level of 83 decibels.

This volume of sound not only exceeds by 7.5 decibels the Bengal tiger's roar above described, but it outdoes as well the thunder of excavating machinery, the sound of police whistles, the noise of loudspeakers in "Radio Row," and the thunder of an elevated train passing overhead on an open structure.

The noise of turnstiles is cause for great annoyance to the average city dweller and many thousands are daily exposed to it. A total of 271 complaints were received against the clatter of turnstiles by persons who answered the noise questionnaire. It was pointed out early in our work that this source could be quieted by mechanical appliances designed to pad and deaden the sound.

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[1] On August 18, Commissioner Mulrooney silenced traffic patrolmen's whistles, depending upon traffic lights alone to keep traffic moving.

Early in April the Interborough Rapid Transit Company notified us that it desired to develop a type of turnstile which would be less noisy than the standard equipment. A device had already been worked out, we were informed, that when attached to the ordinary turnstile greatly silenced it. Tests under laboratory conditions had already been made by the company, but at that time none had been made in actual installations under the pressure in which these machines must work during rush hours.

Toward the end of the month such an installation was actually made in a battery of seven machines at Grand Central Station. A busy entrance—the one that leads from the Terminal to the station under Forty-second Street—was selected. The new devices were put to the test of actual use after a brief ceremony at which were present Frank P. Hedley, President of the Interborough, other officers of the company, and members of the Noise Abatement Commission, the latter being invited by Mr. Hedley.

There is no difference in the operation of the new turnstile or in the speed of the action, but instead of the familiar, earsplitting slam the machine emits only a dull, padded sound—a tremendous improvement.

The officials of the Interborough have expressed themselves as satisfied with the three months' operation of the muffled turnstiles at Grand Central and have set August 5 as the date on which they will begin the installation of similar muffling devices on all their turnstiles—955 throughout the system. The cost is estimated at $19,000.

The Brooklyn-Manhattan Transit Corporation has placed an experimental noiseless turnstile in its station at Pacific Street and 4th Avenue, Brooklyn, where from 13,000 to 15,000 passengers daily pass through each turnstile. This is a mechanical turnstile and the silencing device consists of an oil-operated hydraulic brake with valves, which has been substituted for the mechanical brake. At the same time this device both does away with the sound of impact of the old mechanical brake at each quarter-revolution of the stile and makes the turning of the stile easier. This silencer is to be installed on all mechanical turnstiles throughout the system. The company is also conducting experiments to render the electrically operated turnstiles on its system less noisy.

On the average, 5,600,000 people pass through the turnstiles of the city's transit lines each day and they are subjected to a bombardment of severe noise each time. When noiseless turnstiles are used on all transit lines of the city, one of the outstanding sources of noise will be obliterated.

The contribution of the two great subway systems is particularly to be commended. The Commission believes that it points the way toward a wholesale voluntary quieting of our city by companies now using unnecessarily noisy machinery.

The immediate silencing of all turnstiles and noisy coin machines throughout New York is recommended by the Commission as a relatively simple, inexpensive, and yet important aid in the campaign to spare the nerves and ears of city dwellers.

We wish to point out that good business policy appears to dictate this step. The chorus of favorable public comment that followed the installation of the first silencers by the Interborough showed decisively that good will toward any concern will follow attempts to add to the general comfort and welfare of the public.

The quieting of future subways is another problem—one that has already occupied seven years of study by the Board of Transportation. Chairman John H. Delaney in a letter to the Commission shows that the city's experts, under the direction of Chief Engineer Robert Ridgway, have gone into the matter of preventing noise in the new city subways, investigating silencing devices for equipment, rolling stock, road ballast, and turnstiles. They also have under consideration the advisability of using sound-deadening tunnel linings for the reduction of loud noise caused by fast operation of trains through underground tubes.

The Blare of Horns

In its preliminary noise tabulation, based on the noise questionnaire, the Commission received, 1,087 complaints against automobile horns and similar warning signals. This number was second only to the number registered against noisy trucks, and amounted virtually to 10 per cent. of the total number of complaints against all noises.

It seems likely from more scientific measurements of the part played by automobile horns in the make-up of street noise that this is a fair estimate of the annoyance caused to city dwellers by the various squawks, hoots, shrieks, and trumpetings of our innumerable traffic warning signals. It is even possible that there is no one source of noise in the city causing greater annoyance.

The fact that a great deal of noise from auto horns arises from unnecessary blowing has long been recognized both here and abroad. Motorists are too prone to express their displeasure with traffic waits or to attract the attention of friends by this means. Even in free running traffic some motorists appear to take an almost fiendish delight in sounding their horns when there is nothing in the way.

This problem is further complicated by nerve-wracking sounds which many of the horns now in common use emit. In numerous cases these horns are too loud; in others the design is such that inharmonic overtones are produced that grate on the sensibilities considerably more than could be considered necessary to serve the purpose of warning signals.

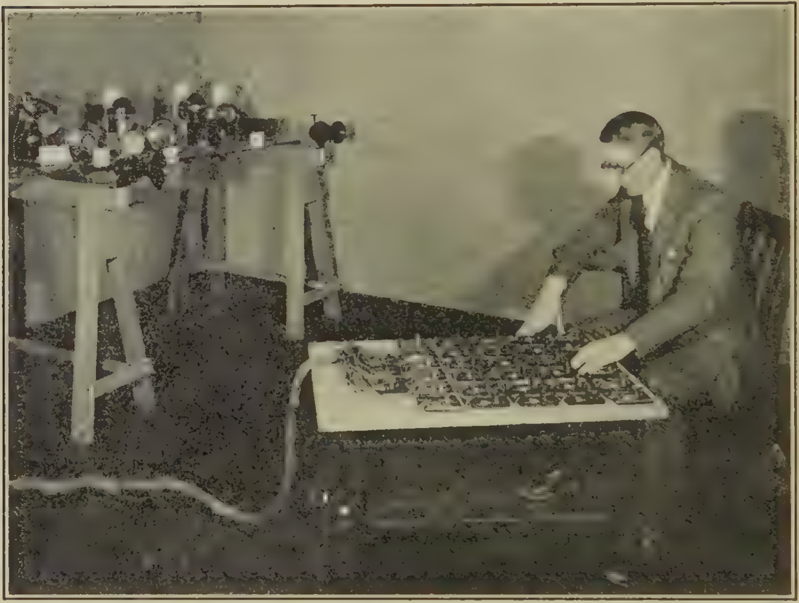
For the reason that there are times when it is necessary that a horn be blown to prevent an accident, so radical a step as the forbidding of all horn blowing is not to be considered. But the Commission early in its work discovered that horns exist which are adequate and still do not bear too heavily upon the nerves of hearers. It found others that were considerably more than adequate in loudness, and more likely to frighten a pedestrian than to warn him, thus tending to cause an accident rather than to prevent one.

The Yardstick of Science Applied to Horns

Precisely what distinguishes objectionable, noisy and frightening horns from pleasanter and equally efficacious signals is not an easy matter for the unaided ear to decide. It was therefore necessary to make a scientific study of all types of horns, measuring their output both as to quantity and quality.

This work, turned over to the committee on Noise Measurement, was undertaken by workers in the Bell Telephone Laboratories. Manufacturers were asked to furnish the Commission with new automobile horns for the tests. Nearly all complied.

After preliminary examinations and comparisons had been completed, thirty-four different horns, representing every type, were mounted in a long row in a soundproof room at the laboratories. All identifying and manufacturers marks were covered. Each horn was numbered plainly and throughout the tests they were referred to by number only.



Photograph by *Bell Telephone Laboratories*

Dr. Harvey Fletcher operating the horns tested by the Noise Abatement Commission

One of the first things definitely proved was that necessary warning signals need not be startling or nerve-wracking. Another was that the average horn is a great deal louder than need be to serve its purpose. The vote of an unbiased "jury" showed that the loudest horns and those having inharmonic overtones were the most objectionable.

To check these results phonograph records were made of actual traffic noise at some of the city's busiest corners. This sound was reproduced at full strength in the soundproof laboratory, and the blast of the various horns hooted into it one by one. It was found that all thirty-four were sufficiently loud to warn pedestrians when masked by the traffic roar. The majority were sufficiently loud to be heard when the sounds of traffic were reproduced at intensities considerably greater than actual conditions would produce.

Further tests showed that some of these horns could be heard, in conditions of quiet, at a distance of ten miles. The voice of each reduced to the intensity that would result from traveling through a mile of air was sufficiently loud to be recognizable.

The sound experts found, as had the committee in England, earlier mentioned, that in general horns may be divided into three classes: motor driven, vibrator, and hand operated. An analysis of the sounds produced showed that both raucous and pleasant toned horns could be produced in each of these classes, but in general motor driven horns more than any other tend to generate overtones of an inharmonious kind.

Such inharmonious overtones are largely responsible for the unpleasant quality of many horns. They frequently cause the startling effect noticed in many loud horns.

The vibrator type horns, on the contrary, were found most frequently to yield warnings with harmonious overtones.

Further analysis indicated that many objectionable horns were unpleasant because of the high frequencies they produced. As a test the sounds of the worst ear-splitters were passed through a sound filter that damped off all frequencies above 4,000 per second. Almost invariably a great improvement was noted in the quality of the resulting warning.

The complete results of these scientific tests on horns may be found in another section of this report.

It was the object of the Commission, in sponsoring this research, to find certain principles upon which specifications might be drawn to guide manufacturers of horns. Bearing in mind the success of headlamp regulation in this country, which cured another evil of the road and street without diminishing the usefulness of motor-driven vehicles, the Commission had in mind the possibility of the voluntary cooperation of manufacturers in its campaign to eliminate harmful and unnecessary noise.

Data sufficient to permit drawing up definite specifications outside of which no auto horns in the future shall be permitted to go are now at hand. As soon as the necessary analysis was completed the attention of manufacturers was called to the Commission's findings.

Early this summer, the Commission held a conference with automobile horn manufacturers from all parts of the country. A demonstration of the horn tests was arranged to illustrate these requirements—showing how loud and of what timbre they should be to serve as adequate warnings and at the same time not be unduly noisy.

The manufacturers were interested in the problem and from their number appointed a committee to attack it from the standpoint of practical production. This committee plans to report back to the Commission at an early date.

Street Car Gongs and Bells

Street car gongs and bells are being tested by Electrical Research Products Inc. in collaboration with the Third Avenue Railway. As soon as these tests are completed, the facts regarding street car warning signals—their present degree of loudness and the possible means of decreasing any unnecessary loudness—will be made available to the Commission.

Unnecessary Tooting of Horns

Of the many complaints directed against automobile horns, a number related to the sounding of warnings by parked cars or autos that are not in motion. Many drivers have the habit of signalling to persons within houses by means of their horns—a habit that is extremely irritating to everyone in the vicinity.

To bring this matter under the direct supervision of the Health Department the Commission proposed an amendment to Section

229 of the Sanitary Code, adding after the word "warning" in the third line of the second paragraph the following:

> "And no such person shall sound a horn or other signalling device while automobile or vehicle is at rest except as a warning in the presence of imminent danger."

Tooting the automobile horn instead of ringing the doorbell is a widespread source of noise

This amendment, which would prohibit such unnecessary sounding of horns and make it a clear violation, is being considered by the Board of Health.

The Noise of Radios

It is one of the curious reactions of the human system that sounds which may be pleasurable at some time are mere noises at others, that music in the home may be disagreeable racket in another's home, that a symphony in the evening may be a nuisance after midnight.

There are two parts to the problem of radio noise; of these the worst and most often complained against is the use of blaring loudspeakers on the street to attract attention or to serve as advertising. Closely allied in this respect with the window buzzers and other racket makers of cheap clothing merchants and auctioneers, the commercial street loudspeakers must be operated at great intensity to be effective. The noise therefore rises above the street traffic level. It is sometimes equivalent to that produced by an automobile horn going continuously at full blast.

In neighborhoods where there are many persons trying to sleep, study, or concentrate, such an outpouring of giant sound can never be anything but torture. The situation is aggravated because of the utter uselessness of the noise, judged from the standpoint of public necessity or convenience. A merchant who resorts to this means of advertising his store or wares is inconsiderate of his neighbors and the welfare of the community; he is a positive menace to peace, comfort, and health.

The Commission has had cases called to its attention where these loudspeakers in residential neighborhoods poured forth their intolerable clamor all day long and far into the night. Protests to the owners were useless; they refused to be reasonable or courteous, maintaining that every man has a right to operate his business and its advertising as he pleased——a specious argument which, if carried to its logical conclusion, would make the city uninhabitable!

A case in point was that of a proprietor of a radio store in Brooklyn, whose loudspeaker so stirred up his neighbors that they appealed to the courts. He was found guilty in Special Sessions of maintaining a nuisance and was fined $200 in the action, which was instituted by a physician acting at the behest of neighbors.

HOME SEASON SALE
RADIO

Three streets and many isolated store fronts poured forth torrents of sound until the city ordinance sponsored by the Noise Abatement Commission checked this abuse of loudspeakers

The physician testified that the noise of this persistent loudspeaker "was terrible." He protested to the owner about it, asking him at first to tone the thing down a bit. The latter replied, according to the testimony, that the neighbors should "mind their own business."

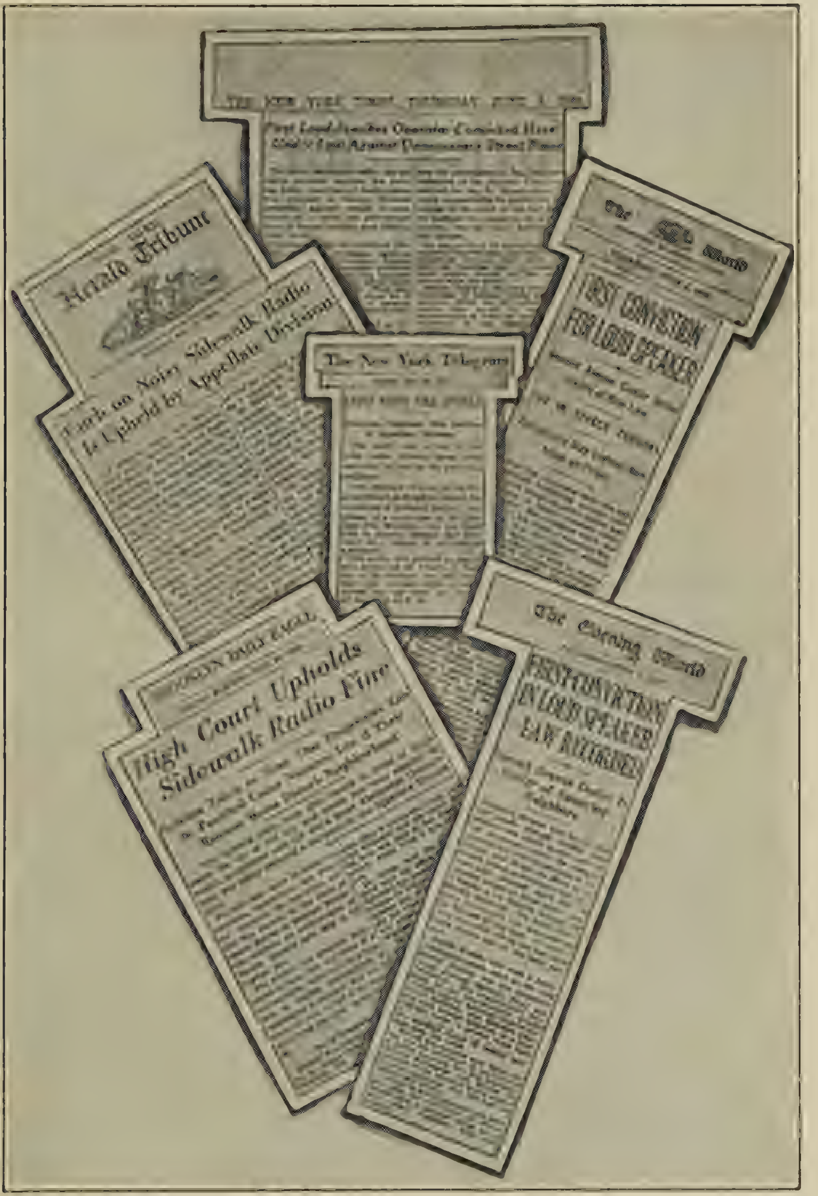
Following his conviction in Special Sessions the radio shop owner appealed. The conviction was sustained by the Appellate Division of the Supreme Court.

Investigations convinced the Commission however, that while nuisance prosecutions of this kind are feasible, a more direct and rapid way of dealing with the sidewalk loudspeaker was necessary. The difficulty of abating a nuisance by legal proceedings is well shown in the case mentioned which took several months to bring to a conclusion. The decision of the Appellate Division may be regarded as setting a precedent that will make future cases of this kind more certain, but it is not so broad as to declare all sidewalk loudspeakers nuisances.

In order that the Health Department might take swift and direct action against loudspeakers' disturbance of the peace an amendment to Article 12 of the Sanitary Code was drawn up by the committee on Practical Application of Remedies of the Noise Abatement Commission. It was adopted by the Board of Health April 8, 1930, as follows:

> "Amendment No. 173-1930
>
> Section 215-a. Loud or excessive noise from radios, etc., prohibited. —No person owning, occupying or having charge of any building or premises or any part thereof in the city of New York, shall cause, suffer or allow any loud, excessive or unusual noise in the operation or use of any radio, phonograph or other mechanical or electrical sound making or reproducing device, instrument or machine, which loud, excessive or unusual noise shall disturb the comfort, quiet or repose of persons therein or in the vicinity."

Under the nuisance law such disturbing noises can be declared a public nuisance and abated by court proceedings only when it has been shown that a considerable number of persons had been disturbed or annoyed by them. This amendment to the Sanitary



THE NEW YORK TIMES

First Loud-Speaker Operator Convicted Here
[illegible] Fight Against Unnecessary Street Noise

Herald Tribune

Curb on Noisy Sidewalk Radio
Is Upheld by Appellate Division

The World

FIRST CONVICTION
FOR LOUD SPEAKER

The New York Telegram

BROOKLYN DAILY EAGLE

High Court Upholds
Sidewalk Radio Fine

The Evening World

FIRST CONVICTION
IN LOUD SPEAKER
LAW AFFIRMED

When the first radio fine was imposed

Code makes the employment of such noises a clear violation of law that can be punished like other violations of the Sanitary Code without the necessity of proving a public nuisance.

To assure doubly the effectiveness of these measures an amendment to the Code of Ordinances was proposed by the Commission, and introduced in the Board of Aldermen by Alderman Murray W. Stand. It was adopted Tuesday, May 20, 1930, as follows:

> "Be it Ordained by the Board of Aldermen of the City Of New York as follows:
>
> Section 1. Article 12 of chapter 23 of the code of ordinances of the city of New York is hereby amended by the addition of a new section following section 136, to read as follows:
>
> Sec. 137. Radios, phonographs and other sound devices.
>
> No person shall use or operate, or cause to be used or operated, in front or outside of any building, place or premises, nor in or through any window, doorway or opening of such building, place or premises, abutting on or adjacent to a public street or place, any device or apparatus for the amplification of sounds from any radio, phonograph, or other sound-making or sound-reproducing device without a permit from the police commissioner therefor, nor in any case within two hundred and fifty feet of a school, court house or church during the hours of school, court or worship, respectively, nor within two hundred and fifty feet of any hospital or similar institution.
>
> Sec. 2. The table of section headings of article 12 of chapter 23 of the Code of Ordinances is hereby amended by adding the following line at the end thereof.
>
> 137. Radios, phonographs and other sound devices.
>
> Sec. 3. This ordinance shall take effect immediately."

This amendment will put a stop to offensive noises produced by loudspeakers in public streets and places, but will permit, for reasonable and legitimate purposes, public announcements by loudspeakers, on special occasions in places where citizens will not be disturbed, on permit from the Police Department.

It will be observed that the amendment to the Sanitary Code is broad enough to cover radios privately operated in homes, but so abused by their owners as to disturb neighbors at unreasonable hours. The problem of privately owned radios, is, however, a complex one. It cannot often be settled by resort to law; abatement in minor cases must inevitably depend on the sportsmanship and reasonableness of private radio owners. Except in instances aggravated by wilful disregard for the comfort and rights of others the Health Department can hardly be expected to step in.

The Commission believes, however, that a campaign of education carried on over a reasonable period will result in the cooperation of radio owners.

Last winter, in order to bring speedy relief to citizens who were annoyed by other persons' loudspeakers during the late hours, we asked the radio stations of New York City to aid us in a campaign to educate radio listeners in noise etiquette.

The stations cooperated whole-heartedly. Each night at 10:30 announcements were made requesting listeners to remember that their radios might be disturbing to the neighbors. They were urged to tone down their loudspeakers as an act of good sportsmanship. These announcements were continued for a period of from one month to six weeks. We received many letters from radio listeners and others informing us that they had produced excellent results.

Noise Control in Buildings

In their report the committee on Building Code and Construction states that while it is not possible to eliminate or to even reduce materially many of the noises arising from the normal activities of a busy city, the best that can be hoped for is the elimination of, or the material reduction in the thousands of noises which are as annoying as they are unnecessary and consequently have an unusually disturbing effect upon the human mind.

In passing the committee makes special mention: "For adequate protection from the normal city noises the home owner and worker within the city must continue to look toward improvement in building construction, that is, to the more general use of materials and forms of construction which, both by the reduction of the transmission of sound or by the absorption of sound, will render his home or his place of business a better place in which to live and work.

In recent years great progress has been made in the field of sound control. Certain types of window ventilators will reduce the amount of noise that enters through them; walls, ceilings, and floors, when properly designed and constructed will materially lower the amount of sound transmitted from room to room; and sound absorbing materials will reduce the noise due to interior as well as extraneous sounds. The benefits resulting from noise control are immediately apparent.

In one office where the noise level was reduced from 45 decibels to 35 decibels a group of office workers engaged at a variety of machine operations showed a 12 per cent increase in output. A 42 per cent reduction in errors in the telephone operating room of a telegraph company[1], and a 3 per cent reduction in the cost per message, followed lowering the noise level from 50 decibels to 35 decibels.

In the utilization of building materials and refinements in design to control noise in buildings, it is fortunate that there is a solid scientific background which is generally recognized and accepted by the architectural profession. Indeed, the application of sound control methods in buildings may be considered to be a practical and exact science through the reasearches of the late Professor Wallace C. Sabine, formerly Hollis Professor of Mathematics and Natural Philosophy of Harvard University. Professor Sabine's researches, undertaken in 1895 and continued until his death in 1919, were originally designed to control hearing conditions in auditoriums, but the methods are equally applicable to the control of noise and are in general use today.

Building materials have been devised which absorb sound and especially noise of annoying frequencies, which are just as practical and decorative as any of the older interior finishes, fulfill alike sanitation and fireproofing requirements, and compare favorably in cost to common building interior finishes plus furnishings.

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[1] Data furnished by American Telephone and Telegraph Co.

In the business world the fact that noise is on the payroll of the average business organization in the form of impaired efficiency or costly nervous strain is becoming widely accepted. Corrective quieting methods are rapidly coming into general use. It is the opinion of the Noise Abatement Commission that the elimination of costly noise in business is so profitable that it is gradually reaching the state of importance accorded to other building problems such as lighting, heating and ventilation; and the citizens of New York are rapidly being relieved of this handicap to their health and efficiency during working hours.

The Noise of Progress

Last December the president of a company erecting a building at Broadway and Wall Street sent engraved apologies to 550 of his neighbors in the vicinity, inviting their indulgence while the fifty-four stories of his new structure were being riveted together.

"May we hope," ran the apology, "that you will bear with us as patiently as possible during the unavoidably noisy weeks that lie just ahead while the steel frame of our headquarters building is going up? To us, naturally, the sound of riveting means gratifying progress toward completion of the building. To our neighbors it means a most unwelcome distraction."

Somewhat later another builder erected the following sign upon the partly completed structure at Gramercy Park in which his riveters were making their characteristic din:

OUR SINCERE APOLOGIES
TO OUR NEIGHBORS
FOR THE UNAVOIDABLE ANNOYANCE
THIS HAMMERING MUST OCCASION

There is no doubt that these friendly gestures of apology toward the inarticulate thousands that have been tortured by building noises did much to overcome the immediate annoyance. But in the long run little protection is afforded raw nerves by

The song of the riveters. 789 buildings in Manhattan alone were built and altered in May, 1930—a typical building month!

politeness when the cause of the suffering is the racket of riveters or pneumatic drilling tools pouring out noise at a loudness of 95 to 99 decibels. These thoughtful gestures speak highly for the kindliness and good manners of modern builders, but by their futility they afford a strong argument for the necessity of finding some way to do away with the major noises of construction and demolition.

An analysis of the noise complaints received in answer to the Commission's questionnaire indicates that about 7½ per cent of all complaints related to these noises. But only 3½ per cent were directed against the noise of riveting the joints in steel frame buildings by means of pneumatic hammers. This seems a small percentage of complaint against this noise, in view of the great amount of public comment upon it continually heard. It is safe to assume that the fewness of the complaints was not due to the failure of riveting to annoy—this noise is especially objectionable because the steel frame of the building acts as a resonator—but to the entirely human habit of forgetting, as soon as the building is up, the racket that attended its construction.

It is likely that the complaints against riveting received in answer to the noise questionnaire were sent mostly by persons who were then being subjected to the sound of riveting. The thousands who had been tortured by it more or less in the past no longer were prompted to complain against it since it was not an active cause of annoyance to them at the time.

As to its abatement, the committee on Building Code and Construction made a detailed investigation. It learned that outside of shops, where comparatively noiseless pressure riveting can be used, there has as yet been no practical method devised of driving rivets other than by means of the pneumatic hammers.

Another method of joining steel members together, however, has been widely experimented with. It is called fusion welding —a process that fortunately can be carried on without causing appreciable noise, and one that appears to be practical, though experience with it on large construction units is still limited.

Experimental work on welding structural steel has been carried on by the Westinghouse Electric Manufacturing Company, the General Electric Company and many others. Lately the experiment passed out of the laboratory stage and was applied on a large scale in certain sections under careful supervision. About fifty industrial and office buildings, department stores, apartment houses, additions to hotels, and one or two bridges have been erected in this country in which welding has been used, entirely or in part.

The largest of these welding construction jobs, and one that will be of great service in showing whether or not the method is practical for New York, is now under way at Los Angeles, where a twelve-story office building is being erected for the Southern California Electric Company. The steel in this building will be 75 to 80 per cent welded. Another tall structure on which the builders intend to use welding is that of a fifteen-story office building for the Boston Edison Company.

Aside from the as yet experimental nature of this process, the chief impediments to its more widespread use are the restrictions contained in the building codes of cities throughout the United States. Already, however, sixty-four cities in the Pacific Coast section have recognized arc welding of structural steel in their building codes under certain conditions and the movement is spreading.

The city of Pittsfield, Mass., adopted the American Welding Society Code for fusion welding in July 1929. Unofficial information is at hand signifying that other cities in the East and Middle West are also considering the adoption of the code.

In New York City the Merchants' Association, through its sub-committee on Minimum Loads and Structural Steel and Iron of the committee on Building Laws, carried on an investigation of the problem and reported that riveting and bolting should be permitted under restricted conditions in the interest of economy and to help in the reduction of noise. With regard to bolting in structures of medium height, where no wind stresses are involved, the committee found that there was considerable experience and precedent to justify it, and that permission in the building code to use this method was desirable.

The following clauses, designed to legalize welding in New York City and to permit the use of bolting under certain special conditions in the place of riveting, were included in the committee's report to the Merchants' Association:

> "*Welding.* Fusion welding may be substituted for, or used in combination with riveting or bolting to connect or assemble the component parts of steel beams, girders, lintels, trusses, columns, and other structural steel used in building construction if done under rigid inspection and specifications, in accordance with the rules of the Board."
>
> "*Field Riveted, Bolted and Welded Connections.* In all tier structures less than 125 feet in height, in which the height is less than 2½ times the minimum horizontal dimension, all column splices and field connections may be bolted.
>
> "In all structures over 125 feet in height, and in structures of a special character, connections of beams and girders within 3 feet of columns shall be riveted or welded. Column splices in structures 200 feet or more in height shall be riveted or welded. Column splices in tier structures less than 200 feet in height may be bolted. All other connections may be bolted, except that, in all structures, the supports for running machinery or other moving loads, shall be riveted or welded."

In these recommendations the committee on Building Code and Construction of the Noise Abatement Commission concurred. The adoption of these clauses in the building code offers a practical solution of one phase of the perplexing noise problem. If these recommendations are carried out the noise caused by riveting will ultimately be greatly reduced.

A further recommendation is that the Sanitary Code be amended to limit riveting in residential districts to daylight hours. The proposed amendment prepared by the committee on Practical Remedies is as follows:

> "In residential districts between the hours of 5 P.M. and 8 A.M. no person shall operate in building operations, including construction, alteration, demolition and excavation, any machinery which, by its noise shall disturb or annoy any person in the vicinity thereof."

The present predominance of noisy trucks and building equipment leads to the belief that many manufacturers, like contractors, lean toward this type of product on the assumption that considerable mechanical din gives the impression of power and sturdiness. There is engineering authority for the statement that quiet trucks and machinery in general may be the more efficient, and certainly there is no valid reason, in most cases, why noise may not be eliminated in equipment of this kind.

The Commission believes that the trend will be toward trucks that are designed for quiet as well as for power and strength, and other building and excavating equipment more kindly toward the ears and nerves of those who must work or live in the vicinity of a building operation. Manufacturers who undertake the work of designing quiet as well as sturdiness into their product should be encouraged and praised.

Demolition and Construction Noises

A great many complaints received by the Department of Health related to noises incidental to cellar, street, and subway excavations, and building foundations.

These noises result largely from the use of excavating shovels, rock drills, pneumatic and steam hammers, hauling apparatus, hoisting machinery, and similar heavy equipment. In some cases the noise appears unavoidable, but in many there is reason to believe that contractors encourage the din stirred up by their employees and apparatus, apparently under the impression that a good deal of racket promotes speed and efficiency and is an indication of power and activity.

As far as we have been able to ascertain, no provisions have ever been incorporated in any municipal building code in the United States to regulate the use of machinery employed in the construction of buildings or other structures. Nevertheless, the time has come when the attention of manufacturers and users of contractors' appliances should be forcibly directed to the fact that when such equipment is to be used within the confines of a municipalitiy its operation must be made as noiseless as is practical.

Nothing can be accomplished, however, by simply calling attention to this situation. The most likely remedy is not to permit within the city after 5 P.M. and before 8 A.M. any con-

Excavation noises call forth many complaints each year

struction activity in which unnecessarily noisy equipment is used. Under no conditions should internal combustion and steam or compressed air engines be permitted to operate without mufflers or silencers attached to the exhaust. Adequate mufflers or silencers should be required on the intakes of all air compressors.

To this end the committee on Practical Remedies has prepared this proposed amendment to the Sanitary Code:

> "No person shall operate or cause to be operated any internal combustion engine, air compressor or steam engine, unless the same is equipped with a muffler or silencer which will prevent loud or explosive noises."

What About Subway and Street Car Noise?

In the design and construction of existing subways in New York it appears that little attention was given to the reduction of noise resulting from their operation. From an engineering standpoint it is possible even now to reduce the noise of subway and elevated operation to a great extent, but the cost would be so great as to be prohibitive.

The Commission recommends that the Board of Transportation[1] study and investigate all available methods of construction and types of equipment, which have been devised to reduce the noise incidental to subway and elevated operation. In this way measures for the reduction of noise which have been found practical can be incorporated at relatively low cost in future subways.

In addition, the Commission feels it reasonable to demand of operators of all existing subways and elevated lines that rolling stock, switches, rails and rail joints be kept in the best possible operating condition. This, together with the elimination of noisy turnstiles, will go far toward reducing the noise from these sources.

As to street cars, various types of wheels and sound absorbing aprons have been used and tested in other cities, both in the United States and Europe. Some of these expedients have worked with a fair degree of success, but the equipment is necessarily expensive, and since no one can predict the future useful life of our surface car system, it would be unfair to the owners to compel them to make extensive costly modifications of their rolling stock.

It is not too much to demand, however, that as in the case of subways and elevated railroads, operators of street cars be compelled to keep their tracks and rolling stock in as fair a condition as possible.

The Commission has received a number of complaints with regard to street car noise, referring particularily to a new type of bell or gong installed on the roofs of trolley cars in certain sections. This device appears to be exceedingly annoying to residents along the lines traveled by these cars.

We recommend that the Transit Commission be requested to investigate all cases in which loud bells or gongs are used on street cars, and to eliminate them if it should be found that the type in question is unnecessarily loud.

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[1] See account of study made by the Board of Transportation, page 195 of this report.

As a Commission, we recognize that the above recommendations dealing with subway and street car noise are very general and at best will require a long range program to bring about even moderate relief from noise generated at this source. On the other hand, the splendid cooperation already received from officials in charge of rapid transit facilities in New York indicate not only that numerous steps can be taken to bring about a measure of relief, but these officials are keenly alive to the advantage to themselves of making their facilities appeal, as far as possible, to the millions of their customers who use them. Noise is the only one of the problems with which they are confronted. There are practical limitations which limit progress. However, progress will continue to be made as the public becomes conscious of the greater comfort to be derived from traveling under quieter conditions.

Looked at from the standpoint of reduction of noise over the long range period, it is the opinion of the Commission that as city planning develops and the difficulties of transportation increase, it will inevitably come about that in large cities such as New York all rapid transit facilities will be underground and street cars and elevated railways eliminated. This, however, gives little promise of a quieter city to the present generation, who must look for relief to the vision and cooperation of the present transportation organizations to eliminate, as far as practicable, the sources of noise that are inherent in the present system.

The Problem of Enforcement

The Commission has found that there are already a number of laws in the Sanitary Code and the Code of Ordinances prohibiting noise, which, if enforced, would go far toward making the city quieter.

Mufflers on all motor vehicles, for instance, are required by the Code of Ordinances. Exhaust horns as warnings are prohibited. General provisions prohibiting unnecessary noise in the streets include regulations relating to peddlers and hawkers and the hours in which they may cry their wares. The use of noise to attract persons to an auction or sale is prohibited. According to law no one may maintain a noisy bird or animal or discharge fireworks or firecrackers without a license.

These are only a few of the regulations now on the law books. They are chronically unenforced. Heavy penalties in most minor regulations tend to make them ridiculous. It is inconceivable, for example, that any magistrate would punish a man for spitting on the elevated or subway trains by a fine of $500 and imprisonment for one year.

A matter that works even more against enforcement in the case of so-called petty offences is the necessity for police or health officers, following the issuing of a summons, to appear in court againt the accused. Under present procedure every petty arrest or summons means a day away from duty for the arresting officers; for routine cases this is wasteful and costly out of proportion to the seriousness of the offense. The machinery of enforcement is today so awkward and cumbersome that the city is penalized more than the offender.

Already a large proportion of the city's enforcement officers, estimated at 1000, are off duty every day to attend court. If an attempt were made to enforce the lesser laws regarding unnecessary noise this proportion would be increased out of all reason.

Further, the courts are already crowded. An influx of minor cases would cause a hopeless clogging of calendars and slowing down of justice, so that all cases, serious and petty alike, would suffer.

Nevertheless, it is apparent that we must have regulations prohibiting certain nuisances, and these regulations must be enforced. Experience shows us that the control of unnecessary noise requires an officer of the law with clear authority to act. If he is discouraged by reason of inconvenience or lack of authority from performing his duty in cases where a warning is insufficient, there can never be control of these nuisances.

The Commission, considering these factors of the complex problem of law enforcement as it relates to unnecessary noise, recommends the adoption by New York City of a plan for the administration of minor regulations which is new here, but which has been used for some time with success in European cities.

The Proposed Fine Amendment

Simply stated, it is as follows:

In the case of minor offenses constituting violations of the Code of Ordinances, including the Sanitary Code and Park Ordinances, but not involving serious danger to health, morals, safety, or public welfare, the heads of the departments charged with the administration of regulations concerned with these offenses shall prepare a schedule of them with fixed fines for each. No such fine is to exceed $5 for each offense.

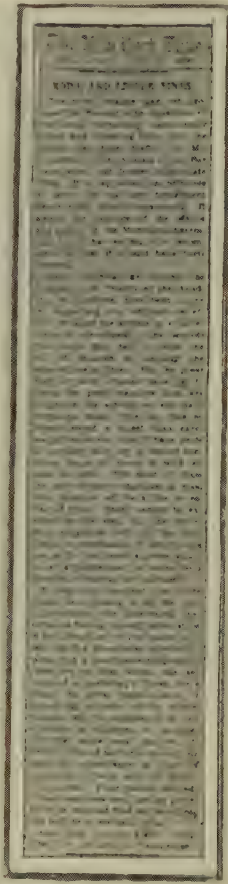
The department heads are further empowered to authorize the police or appropriate department representatives to give notices of violation to offenders who break the regulations and who admit their guilt in preference to taking their case to court.

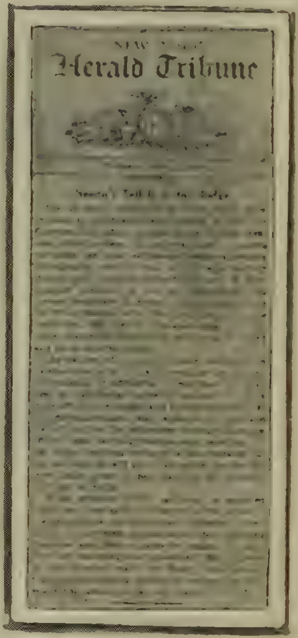
The notice of violation shall be returnable at the office of the Chamberlain of the City of New York, where the fines will be received and a receipt therefor given the offender. Later the Finance Department will allocate the money to the various funds to which such fine money is assigned by law.

It will be seen that under this plan the Health Commissioner, the Park Commissioner, and other department heads under whose jurisdiction most of these petty regulations fall will be able to direct enforcement without adding to the burden of the courts in cases where the offender, caught in the act and willing to pay his fine in preference to appearing in court, will accept the notice of violation. It is believed that the majority of cases can be settled speedily in this way. This method of effecting immediate punishment will serve as a deterrent more powerful than the threat of long-drawn out and uncertain court action.

If the accused denies his guilt, or expresses a desire to have the matter taken to court, he may refuse the notice of violation, in which case the arresting officer may issue a summons.

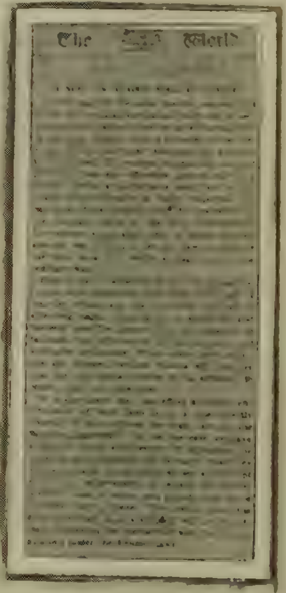
The proposal in no way abridges the rights of any citizen. Neither does it prevent the police or representatives of any department from serving a summons in a proper case or making an arrest as provided by law.





NEW YORK

Herald Tribune



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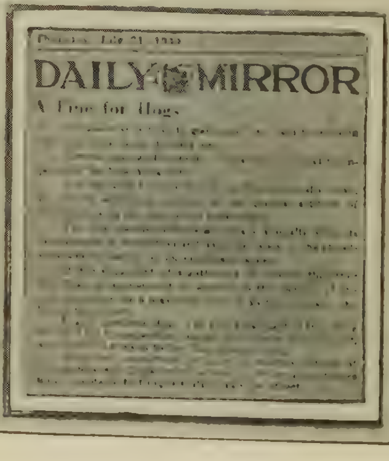


DAILY MIRROR

This proposed amendment is a far reaching one, covering not only noise regulations but many other minor laws in the Sanitary Code, Park Ordinances, and Police Regulations.

Its advantages in assuring a quick and certain enforcement are obvious. In the opinion of the Commission, the plan is sufficiently sound to merit a trial.

The Commission therefore proposes an amendment to the Greater New York Charter as follows:

> Section 113. In the case of minor offenses constituting violations of the Code of Ordinances, including the Sanitary Code and Park Ordinances, and not involving serious danger to health, morals, safety or public welfare, the head of any administrative department the administration of which is concerned with any such violations is hereby authorized and empowered to prepare and promulgate a schedule of such offenses with fixed fines or penalties applicable thereto not to exceed five dollars for each such offense to be paid by offenders who confess violation of the same and who do not desire a judicial hearing. Said department heads are further authorized and empowered to make uniform rules regulating the giving of notice of such violations by department representatives. Any notice or violation hereunder shall be returnable at the office of the Chamberlain of the City of New York, who shall make proper provision for the receiving of payment of such fines (in the several boroughs) and the giving of proper receipts therefor. Each department on the service of any such notice shall immediately notify the said Chamberlain thereof, and in case any violator shall fail to pay such fine within the time specified therefor the Chamberlain shall inform the department issuing such notice, which shall thereupon cause a summons to be served on said violator. Nothing in this section contained shall prevent the police or representative of any department from sending a summons in a proper case or making an arrest as provided by law.
>
> Section 2. This local law shall take effect immediately.

This amendment has not yet been introduced in the Municipal Assembly. Its details have been previously presented for your consideration and to the heads of the other departments concerned for theirs and has your approval and theirs. In addition, when it was first advocated by the Commission some months ago the chorus of popular and editorial approval gave promise of ready public acceptance. The proposal has recently been referred to the Drafting Commissioner of the Municipal Assembly for consideration.

Interim Accomplishments

At the time of writing this report the Commission has been in existence nine months and during that time its work has been carried on along two lines of endeavor—1, preparatory investigations and conferences, and 2, the reduction of specific noises.

Under the first heading come studies made by the different committees and conferences with many different groups as to ways and means of attacking specific noises; while under the second heading come the anti-noise ordinances passed and the definite action secured through the cooperation of individuals and organizations in quelling certain noises.

The study of the effect of noise on human beings made by the Commission reveals that noise as it prevails in our city today is definitely detrimental to the well-being and efficiency of those who live and work here.

The noise questionnaire, devised by the Commission, published by the metropolitan newspapers, and filled in and returned by thousands of New Yorkers, was a valuable guide in charting the sources of city noise, the location of these sources, and the annoyance power of the various noises for further investigation.

The noise measurement survey, following the general outline indicated by the answers to this questionnaire, shows clearly the present noise levels throughout the city, analyses the contributing sources of noise, and provides for a system of future surveys both for checking up on the progress of abatement in the months to come and for measuring new noises should they arise. This survey has been supplemented by a survey of indoor noises, revealing office and residence noise levels in typical locations throughout Manhattan.

A study of automobile horns has been completed, determining the effectiveness of horns as warning devices, establishing loudness levels, analysing tone characteristics, and defining annoyance effects. The results of this study have been taken up with horn manufacturers throughout the country and at present the manufacturers are working out a practical way of meeting the requirements formulated by the Commission.

A study has been made of the Building Code and of methods of construction and transportation. Carefully worked out recommendations have been made for legislation limiting the hours of noisy operations in building construction and the use of silencers or mufflers on engines of the explosion type. Further recommendations for abating certain specific noises of construction and transportation are another result of this study. Advancement in the science of construction, operation, and maintenance of machinery will give great aid in solving the problem of abating noise both in building construction and in transportation. Hence active study along these lines is indicated as part of our future program.

A survey of existing anti-noise ordinances and regulations revealed that many noise nuisances could be abated under laws already on the statutes at the beginning of the Commission's work. Regulation of radio, however, required new laws definitely dealing with the abuse of this modern invention. In April of this year the Board of Health added Section 215-a to the Sanitary Code, prohibiting loud or excessive noise from radios, etc., and in May the Board of Aldermen added Section 137 to the Code of Ordinances, prohibiting the use of radios, etc., in front of buildings. In addition to these accomplishments, other legal measures have been prepared and recommended, namely: Section 229, Sanitary Code, prohibiting the sounding of horns by automobiles not in motion; Section 229-a, Sanitary Code, requiring mufflers or silencers on engines; and Section 229-b, Sanitary Code, restricting hours of noisy building operations.

With a view to making easier the administration of noise regulations Section 113 has been proposed as an amendment to the Greater New York Charter, thus providing a method for imposing small fines in connection with violations of noise and other minor ordinances in such a way that the courts will not become congested by such cases and the time of policemen and health officers not be absorbed by required appearance in court. It would be a step forward in law administration for the metropolitan area and in no way infringes on a citizen's right to trial if he so chooses.

The Conference on River and Harbor Noise was held in January, representatives from steamship and railroad companies meeting with the members of the Commission. A special committee was appointed at that time to investigate ways and means of reducing the need for noise signals on the waterways touching upon New York City. In the meantime as a result of this conference severe enforcement of existing legislation prohibiting unnecessary blowing of whistles has been made possible by the Steamboat Inspection Service, the services of the Captain of the Port and of the Supervisor of Harbor, and the Marine Division of the Police Department.

The Interborough Rapid Transit Corporation and the Brooklyn-Manhattan Transit Corporation have developed noiseless types of turnstiles now being installed throughout the two subway systems. In this connection, we have been informed by the Board of Transportation that it is making a study of noiseless turnstiles and other quiet-producing devices with the idea in mind of making the city's future subways as nearly soundless as possible.

The clothing manufacturers' associations have urged their members to purchase only those types of hand trucks that have rubber or fiber tires so that the noise from these trucks used to transport garments from shop to shop in the manufacturing center around Pennsylvania Station will be materially reduced.

The Post Office Department after a conference with the Commission ordered the drivers of their trucks to abstain from the use of cut-outs and sirens except in emergencies to avoid accidents.

The Green Light Club, with a large membership of automobile drivers throughout the country, has developed an educational campaign against unnecessary blowing of automobile horns. Posters, stickers for windshields, and pamphlets have been prepared for free distribution. Chambers of commerce, boards of trade, and other important associations in the five boroughs are now cooperating in the distribution of these reminders to make less noise.

The different city departments have been eager and prompt in handling cases of noises that come under their jurisdiction.

After a week's experiment, Commissioner Mulrooney decided on August 18 to do away with traffic whistles, depending upon traffic lights alone to keep traffic moving.

It is clear that our present achievements are also the seed of future accomplishment. Everything we have done—legislation, the study of mechanical developments in the noise prevention field, securing the cooperation of organizations and individuals in stamping out unnecessary noise—must be carried forward through the months to come, if we are to see the fruitful results of this campaign. We are glad that you, as Commissioner of Health, have asked us to continue our work until the complete program is under way.

Recommendations

We believe that the activities of the Commission to date form a basic outline for the work of noise abatement that must be persistently followed up in the future.

The Commission, in accordance with your original suggestion coming from your experience as Commissioner of Health, did not work on the basis of simply making a report and recommendations for someone else to carry out but throughout its activities tried to accomplish immediately some definite and practical results that would, at least in a small way, indicate what could be done.

The Commission recognizes clearly, however, that these accomplishments, however interesting and valuable, will be dissipated with time unless followed up. Moreover, the possibilities of the future as outlined in this report cannot be turned into actualities through the efforts of a Commission alone. Some means must be provided for maintaining constant pressure in the direction of noise abatement over a period of months and years before really effective results can be obtained.

Therefore, the Commision makes the following specific recommendations:

1. That the city government authorize a noise squad as a part of the Health Department whose duties in the field of noise

abatement will be similar to the present excellent system used by the Department of Health in abating the smoke nuisance. The system used by the Department of Health in investigating noise complaints should be continued and, if conditions warrant, extended.

2. We recommend a comprehensive and energetic educational campaign to arouse public consciousness to the evils of noise and advantages of a quieter city. The general public should be supplied with information which will make clear the methods by which relief from noises can be obtained so that every citizen will know which city department has jurisdiction over various sources of noise and so may send his complaint immediately to the right place and so have it investigated without the delay of rerouting. Individuals should be given a chance to play their part in making our city a more comfortable place in which to live and work. The assistance of civic organizations, clubs, and professional and business associations should be enlisted. Many of these have already declared themselves willing to wage a campaign against certain phases of city noise.

In formulating such an educational campaign, we recommend that the sources of city noise as revealed in the noise measurement survey and as shown on the chart on the inside cover of this report could well be used as a guide. One classification would be the radio, another the unnecessary blowing of horns, another traffic noise, another the noise caused by motor trucks and similar vehicles. Progress in the abatement of some of these noises may be more rapid than in that of other noises, but constant educational effort is needed in every one of these fields if noise abatement is to be an actual fact and not a paper plan.

That we have been able, through the cooperation of many individuals, corporations, and officials to accomplish as much as we have in so short a time encourages the members of the Commission to believe that the campaign for noise abatement, now well started, will be successful and that as a result of its work New York will in time become a quieter, more healthful, and pleasanter city for all who live here. We have evidence that our work is being closely watched not only by other cities in the

United States, but by municipalities in Europe as well. What the City of New York is able to accomplish in this field will be of world-wide importance and it is essential to this accomplishment that the educational work of the Noise Abatement Commission be continued until the noise level of the city is appreciably reduced and the city becomes a pleasanter place in which to work and live.

Lewis H. Brown
Chairman,

Edward F. Brown
Director.

E. B. Dennis, Jr. Executive Secretary.

Albert H. Beyer

James W. Brown

Arthur B. Duel.

Harvey Fletcher

Foster Kennedy

Samuel J. Kopetzky M.D., F.A.C.S.

B. Sachs

Frederick Tilney

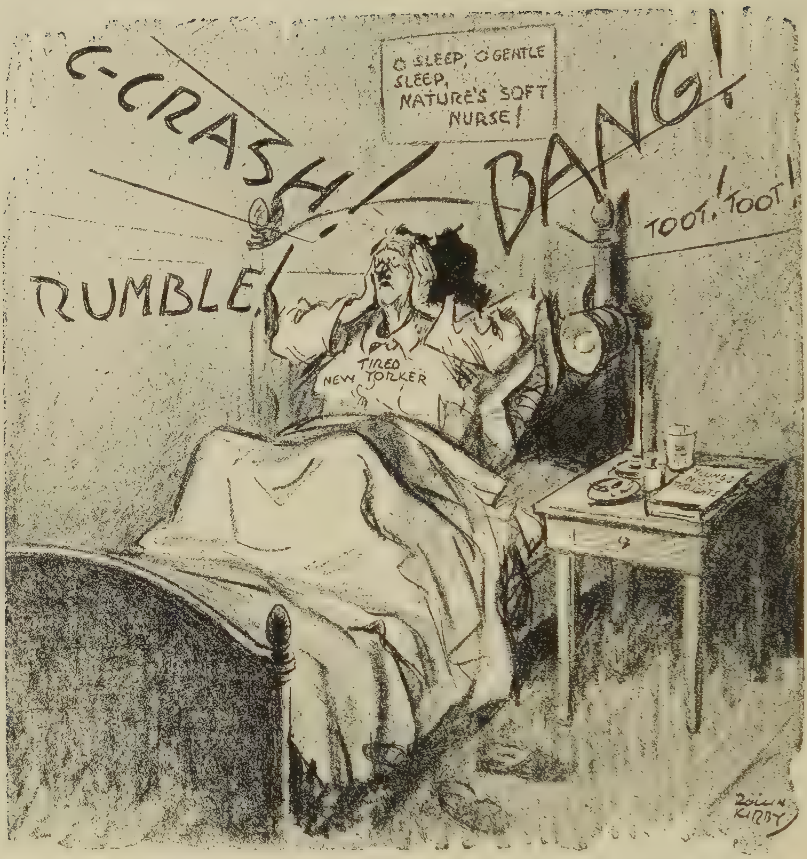
Alexis Carrel

Lawson Purdy

Edward P. Mulrooney

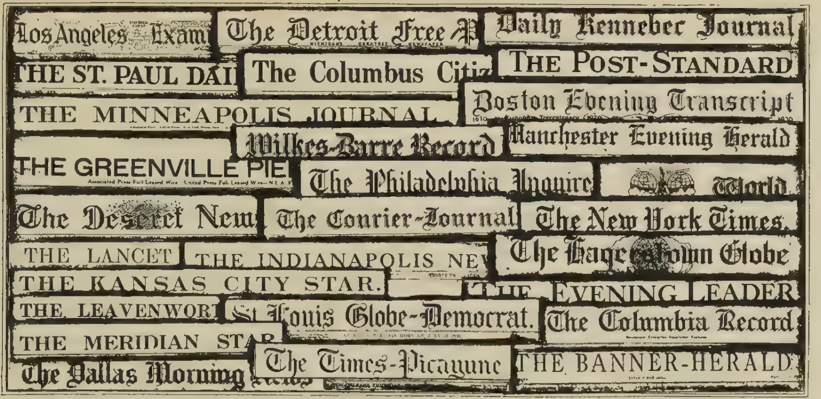
Alfred N. Swayne.

Judge Joseph Eugene Corrigan, Chief Magistrate of the City of New York, and Dr. William Schroeder, Jr., Chairman, Sanitary Commission, Department of Sanitation, became members of the Noise Abatement Commission August 15, 1930.


C-CRASH!
O SLEEP, O GENTLE SLEEP, NATURE'S SOFT NURSE!
BANG!
TOOT! TOOT!
RUMBLE!
TIRED NEW YORKER
YOUNG'S NIGHT THOUGHTS
ROLLIN KIRBY

"I WAKE FROM MY SLUMBER AND LIST TO THE ROAR
AND IT SAITH TO MY SPIRIT, 'NO MORE, NEVER MORE'"

By Rollin Kirby in *The World*


Los Angeles Exam
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Manchester Evening Herald
THE GREENVILLE PIE
The Philadelphia Inquire
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The Deseret New
The Courier-Journal
The New York Times
THE LANCET
THE INDIANAPOLIS NEW
The Hagerstown Globe
THE KANSAS CITY STAR.
THE EVENING LEADER
THE LEAVENWORT
St Louis Globe-Democrat.
The Columbia Record
THE MERIDIAN STAR
The Times-Picayune
The Dallas Morning
THE BANNER-HERALD

Comments from Coast to Coast

THE lively interest of the country in the progress of the work of noise abatement has produced a running comment on the movement showing that every section, every community is somehow affected by the problem of modern noise.

The newspapers throughout the country have long been the unofficial repository of complaints against the growing noisiness of cities. Thousands of citizens, harassed by night noises or daytime din, have written earnest letters to their favorite journals—all urging that "something be done about it." And consequently much editorial thought has been devoted to the subject.

"The evil is not one which the city has suffered in silence," observed the New York *Times* appraising the situation that led up to the formation of the Noise Abatement Commission.

The *World,* founded by Joseph Pulitzer, one of the country's most consistent enemies of noise in the period preceding our present noisy era, devoted a series of articles to the problem in the early fall of 1929. In its opinion, "Things have got to the point where the well-being of all of us is seriously involved; if something is not done they will grow a lot worse."

"Because business makes a noise, Americans have deluded themselves into thinking noise makes business. The more conglomerate and vicious becomes the urban turmoil and din, the more the citizen glows with civic pride," said the Baltimore *Sun.*

Shall We Ever Become Adapted To Modern Noise?

The Omaha *World Herald* said, "The trouble seems to be that our sensibilities haven't kept pace with the change of our dominant noises. We have careened joyously along with life, away from the old idyllic times, with few regretful glances backward. . . . When the time comes when a klaxon soothes us to sleep and our ear can no longer hear such a faint sound as that of a sheep bell, and the clatter of automobiles, racing over the manhole lid in front will lull us to sleep at midnight, then we may say confidently that this life has become really our life and there will be fewer breakdowns."

"Nature normally is quiet. Man naturally is quiet except when stimulated or moved by great emotions. The city noises hence probably jar upon him. In this process of compensation and adjustment there are many, no doubt, who suffer keenly both consciously and unconsciously from the din," was the belief of the Dayton, Ohio *Journal* at the outset of the campaign here in New York, while the Philadelphia *Inquirer* expressed doubt as to the aid we can expect from "compensation and adjustment." "The plea, then, is not for the future race, but for the present one. When street din sets up a series of physiological changes that make taxicab drivers hard of hearing, if not actually deaf, as experiment demonstrates beyond the shadow of a doubt, the time to begin the suppression of unnecessary roars, shrieks and squeaks is now."

The New York City *Post* also expressed doubt on this score: "Noise and more noise is the price we must pay for the development of the modern city and especially its transportation facilities, but this is no reason why we should accept it as a matter of course. . . . If we succeed in inuring ourselves to the perpetual din . . . . the medical experts assure us that it is at the expense of a nervous constitution already badly strained," seconded by the Cincinnati *Star,* which said, " We are living in doubtless the noisiest age of all history . . . . A community must take care of its nerves . . . . the great majority of the citizenry must be protected against a minority."

"What community for example, is free from disturbances by the open motor cut-out, the slamming of motorcar doors, the clanging locomotive bell, the radio loudspeaker?" asked the *Christian Science Monitor,* Boston, Massachusetts.

"And if they (modern noises) grow much worse, neither New York nor any other big city will soon be fit to live in," the Philadelphia *Ledger* said of the need for the Commission's work, and the Cleveland *Press* added, "There can be no question that the effect of repeated deafening and raucous noises must be toward an unstable and neurotic civilization."

"Doctors ranking high in the profession see in the abating of noise one of the greatest problems confronting urban authorities for they already are noting in their daily practice unmistakable signs of the effect on the mind and body of the constant din," declared the Danville Virginia *Bee.*

"Perhaps some day public opinion will regard noise as seriously as it does germs," remarked the Providence, Rhode Island *Journal* following this line of thought.

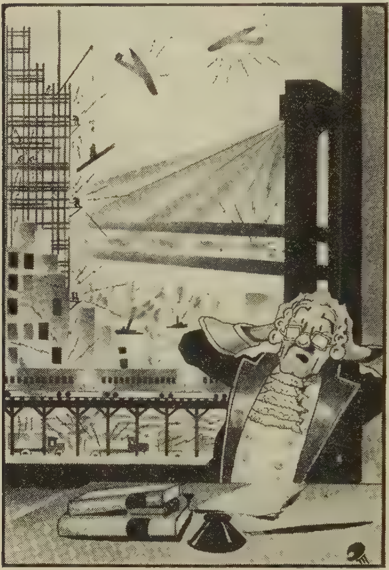
Who Can Solve the Noise Problem?

"This is not a thing to be regarded as trivial, and left to the mercy of fanatics, cranks and scatter-brained folks. Things have got to the point where the well-being of all of us is seriously involved," said the Staunton, Illinois *Times Press.*

And, curiously, the Minneapolis *Star,* just at the time the Noise Abatement Commission was being appointed by Commissioner Wynne, asked, "Why shouldn't the suppression of unnecessary noise be made a job for the health authorities?"

The appointment of the Noise Abatement Commission in New York City was the occasion of country-wide comment and was hailed as a means of help not only to the metropolis, but to other communities far and wide. "New York opens war on noise," said the New York *Journal.* "It is the first time any American city has sought a real solution of this great problem."

The Kansas City *Star* said, "The movement is interesting and its outcome will be awaited with deep interest over the country."



By John Malone in *The New York Times*

"It is in order to give three cheers to the anti-noise movement provided the cheers are quiet ones," the Oakland, California *Tribune* added, entering into the spirit of the occasion.

Said the New York City *Post:* "Perhaps if we make a big noise about it, we shall some day get rid of the noisy noises that afflict our cities. . . There are things which any civilization that respects itself must suppress and one of these things in our civilization is excess noise."

"And now a hand has been lifted up against the NOISE of a city," commented the New York *American.* "Peace and quiet must always have a high value to a civilization that hopes to progress sanely. Dr. Shirley W. Wynne, Health Commissioner, has attacked the problem vigorously. . . . We accept noise as the inevitable expression of activity. It is not. The most perfect and most powerful motors run silently. . . . Fifty per cent of the noise of the city is lawlessness and not necessity."

Not Solely New York's Problem

The Louisville *Courier-Journal* spoke in the same vein, "But the question is, are all these (city noises) necessary concomitants of progress. . . .A noiseless city. . . .is apparently not the aim. The elimination of useless noise is an object which New York is not alone desiring."

The Christian Science Monitor observed, "Emphasized by intrinsic merit rather than by spectacular prominence in the day's news, the recent appointment in New York of a committee for the abatement of noise must have surprised and delighted many readers throughout the United States. . . .New York has set an example that might well be widely followed."

"In the East campaigns are being put on to eliminate unnecessary noises. It would be a fine thing if the sensible idea spread to the West," remarked the Leavenworth, Kansas *Times*.

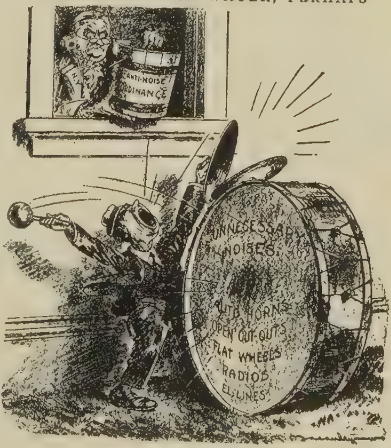
The Montreal, Canada *Star* observed, "The urgent need for an effective campaign against noise has become more and more obvious during the past few years. . . .Would it be asking too much to invite the attention of the civic authorities of Montreal to the manifold and discordant noises that often make night hideous in this metropolis?"

The Boston *Traveler* said, "The city of New York is making a serious campaign against noise. . . . We believe that Boston should appoint a noise abatement commission. . . ."

"Suppression of unnecessary noises is by way of becoming an international business, and those pioneers who, in years agone, contributed to the gaiety of their neighbors by demanding protection against dins that murdered sleep. . . .no longer are without honor in their own countries," said the New Orleans *Times-Picayune*.

And the New York *Post*: ". . . .the newly appointed anti-noise commission might look over the bill which has been introduced in the Municipal Council of Budapest. No half-way measures are to be adopted. . . . Noise is simply to be banished once and for all. . . . The only danger will be that so many people will be attracted to Budapest. . . .that in their enthusiastic outbursts in praise of the quiet nobody will be able to hear himself think."

A DASH OF COLD WATER, PERHAPS



C. R. Macauley in *The Brooklyn Daily Eagle*

The Lancet, speaking of the noise problem in England, commented, "Our noise problem may not be as serious as that of New York, but it is certainly bad enough, and it is to be hoped that those who suffer from the effects of modern noise will join with those who are concerned about its effect on the public health and create that public demand which alone can produce the supply of noise-proof devices for our homes and work rooms."

The Columbia, S. C., *Record*: "All are interested in the Wynne program. When his committee solves the problem others will profit by it." "The same problem faces all cities to a greater or less extent, and the country will watch the campaign with interest," said the Dayton, Ohio *Daily News.*

The Scranton, Pennsylvania *Republican*: "New York is giving more than usual attention to them (noises) but in all cities, including Scranton, they are the cause of much discussion. . . .To what extent this abatement can be put in effect in New York or elsewhere remains to be seen but the effect of the commission's recommendations and the endorsement they have received should develop excellent helpful results."

The Greenville, South Carolina *Piedmont* said, "A similar campaign, if it could be made effective, would do no harm to any smaller city, such as, for instance, Greenville. . . .the weight of evidence so far is unfavorable to the noises. Nobody's nerves would suffer if they (noises) are reduced."

"In any event, we have too many noises in these American cities and we should begin to work out plans to get rid of as many of them as possible," remarked the Sheffield, Alabama *Tri-City Daily.*

The Syracuse, New York *Post-Standard:* "Nowhere else in the world is there such a concentration of diversified noises as in New York City. The noise problem is there, at its worst. Other cities, like Syracuse, however, have enough to cope with. And the eye of all of them will be upon New York in the latter's endeavor to subdue the ever increasing clamor. . . . If the commission can accomplish something in the heart of Manhattan, all elsewhere will be encouraged to follow the example set." The Albany *News:* "It will be no simple task to abate noises in cities but at least a movement in this direction has been started and it ought to have every encouragement."

"The relief from noise for the tortured New Yorker is obvious—there are thousands of other cities, towns and hamlets in the United States, in which there is less noise, not to mention the great open spaces," said the Danville, Virginia *Register,* urging New Yorkers that if they cannot get rid of the noise, they can seek a quieter habitat, while the Chicago *Post* remarked, "Doctors say that we are becoming a nerve-racked nation. . . . It is the man in the country only who escapes. We cannot all go to the country to live. Something ought to be done to make the cities livable."

Abatement No Easy Task

The Worcester, Massachusetts *Post* commented, "As New York City generally is accredited with a greater volume and variety of noise than any other community in the world its noise commission has a full sized job on its hands." The New York *Evening World:* "Meanwhile, as the commission gets down to work, the community is to be congratulated on the determination of the Health Department to give it better protection against unnecessary nerve-wracking, sleep-preventing noises than it has ever had before. This work is long over due."

The New York *Post,* speaking of the task before the Noise Abatement Commission said, "It is beyond the commission's powers to cloak the city in sudden quiet, but conditions can easily be improved if its work receives the support it deserves." The New York *World:* "The work laid out for the Noise Commission is complex and difficult. . . .The work will take time. . . .Dr. Wynne pledges himself to patience in that matter."

"No wonder," remarked the Brooklyn *Daily Eagle,* ". . . that the commission includes among its members a builder, a research engineer, and a lawyer. They will have plenty to exercise their especial attainments."

The Carbondale, Pennsylvania *Leader* observed, "That it intends going into all phases of the problem is indicated by the personnel of the group."

"The Noise Commission appointed in New York, the first body of its kind ever created, consists largely of scientists. The incident is a reminder of how little science has done to cure these sore spots in modern civilization," was the comment of the Philadelphia *Inquirer.*

The New York *Herald-Tribune:* "What the matter now needs is practical common sense, which is exactly what the new commission may be expected to provide."

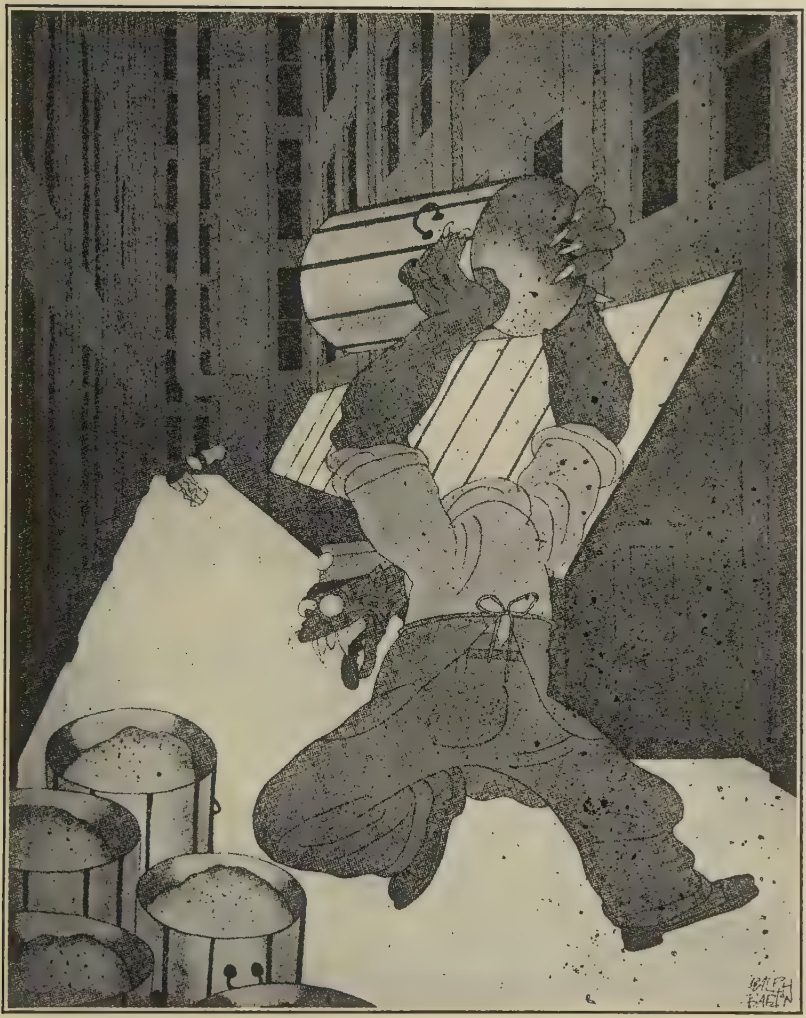
The Syracuse *Post-Standard* struck a skeptical note and wondered, "if they (the members of the commission) will be able to suppress noises as fast as new ones are created," while the Rochester *Chronicle* believed that the noises are not entirely to blame and said, "Imagination plays a large part where noise is concerned, and imagination can be controlled to some extent."

Questionnaires

When the Noise Abatement Commission issued its questionnaire on annoying noises, the Providence, Rhode Island *Journal* remarked, "Now is the time for all tortured victims of indiscreet radio loud speakers, over-zealous music students, early morning milk-can rattlers, roistering whoopee parties, excessive motor horn tooters and so forth and so on to come to the aid of a vast army of sufferers."

The New York *World* said, "In the first place, it (the noise questionnaire) will inform the commission as to the noises which actually annoy people as distinguished from the noises that are supposed to annoy them but don't. In the second place, it will enable the commission . . . to mark out those areas . . . . where noise is especially annoying and concentrate on them."

The Syracuse *Post-Standard* fretted at this preliminary questionnaire: "Before it (the commission) does anything it must have a survey . . . . So everything starts with a questionnaire . . . . But a Noise Abatement Commission would win favor quickest by really abating something. . . . But that, however, would be quite irregular." "Everyone should be glad to co-operate," said the New York *Journal* "by telling such sympathetic listeners about the rackets that annoy them."



By Ralph Barton in *The New Yorker*

THE SORT OF THING THAT BRINGS JOY TO THE ASHMAN'S BLACK HEART

A Whole, Nice, New, Big, Twenty-story, Co-operative Apartment House to Wake up at Six in the Morning

When the Noise Measuring Truck was Busy

The survey which followed is now being made public for the first time, but, while the noise measuring truck cruised the streets of New York, editorial comment followed its course with interest. "It doesn't make much difference, of course, to the average New Yorker whether the noise level outside his house or office is 63 or 36 decibels," said the New York *Telegraph*. "When it's noisy, he knows it. But he should be interested in the fact that the valuable work of the Noise Commission has begun and that its experts have the most advanced scientific apparatus available to assist them in their measurements."

When the noise-measuring truck revealed that Brooklyn held many comparatively quiet spots, the New York *Journal* said, "It is pleasant to learn that the city of churches, homes and baby carriages is comparatively rubber-tired. But the news should not blind us to the fact that, although Manhattan shouts and Brooklyn whispers, the latter's voice is still a stage whisper which can stand a lot more moderation."

The New York *Post* commented on the discovery that quiet can be found in the rooms just above the set-backs in the new towers of this city. "It is very cheering to discover that a development which has been devised for the sake of one effect is resulting in another hardly less desirable."

The High Cost of Noise

The high cost of noise was not overlooked by the press. The Seattle *Times* said, "It is hard to appraise the cost of noise in dollars and cents. But there is a very real financial loss due to noise. . . The high cost of noise makes the infernal din of American cities their most expensive luxury."

The New York *Journal* commented briefly on two of the causes underlying this economic loss, "Noise destroys working efficiency by day. And, far more important, it destroys sleep by night." And the Ottawa, Canada *Citizen* said, "Noise . . . . not only means loss of comfort but loss of sleep—loss of energy—loss of temper and loss of efficiency as well. Even if it costs nothing else, it costs money," while the Boston *Traveler* remarked, "Noise costs money. It lowers efficiency. It causes waste. It shortens life," and the Brownsville, Pennsylvania *Telegraph* added, "Noise is not always easy to be eliminated but if that elimination means savings for the business man it will be brought about if it is humanly possible."

Another cause back of the high cost of noise is touched on by the New York *World:* "When people are harassed by the noise of a given locality, they move out of it. That means a definite decrease in the value of its property."

"Noise is costing this metropolis untold millions a year," said the New York *Mirror.* "Anything that reduces noise is worth while. Whoever makes money out of silencers not only deserves it but is worthy of the gratitude of a noise-wracked, nerve-wracked city."

Following the action of the various business associations of New York aligning themselves with the noise abatement movement, the Boston *Globe* remarked, "If other urban centers will borrow a hint from the property owners of New York, America may yet be transformed into a place where quiet is possible and nerve strain is diminished."

And the Miami *Herald* mentioned Miami's local problem: "As a result of representations made by a delegation, the City Commission has asked the Greater Miami Hotel Association to investigate the question of noises in the business district. These are annoying and, as they disturb guests, they have the effect of shortening their stay and driving them away. . . . While stepping on the gas let's step on the sound and halt the broadcasting of traffic noises."

"Now the British are getting after unnecessary noise with the medical profession taking the lead . . . . though England suffers less in this respect than America," said the Burlington, New Jersey *Enterprise.* "There is an American touch in the British estimate that this loss costs the country $5,000,000 a week in diminished working efficiency."

"A new branch of science is in the process of development . . . the science of noise control. . . . Humane considerations should be sufficient to bring about reduction of preventable noises in cities, many of which disturbances are wholly unnecessary. But most rapid progress may be expected when it has been convincingly shown that quiet is an economic factor worth cultivating," was the opinion of the Kansas City *Star.*

Noise also a Factor in Accidents, Crime, Etc.

As factors in this great economic loss, the Providence *Journal* mentioned noise as a likely cause of accidents and as a possible aggravation of crime psychology, saying, "Here are two theories in relation to two of the most vital present-day problems in American life which are entitled to the most thoughtful consideration. They demand the searching study that will lead to effectual remedies. . . . ."

The Philadelphia *Record* also commented on noise as a precipitating factor in crime: "Crime and hysteria are closely related. The first offense in a career of law-breaking is apt to be done on impulse, in a moment of heightened emotional tension. . . . How many street noises are responsible for the neurotic, hypersensitive state of mind which responds to criminal suggestion it is extremely difficult to say. . . But the noisy trucks, the sirens, the bells and whistles which completely surround the street boy in the poor sections of large cities force him into abnormal mental activity. . . This relation of noise to crime is one worthy of deep consideration."

"If the boy in the city streets is keyed up, to a fighting pitch by his fear reaction most of the time, because of the noises that constantly assail his ears, it is small wonder that he becomes, so often, the gangster who is always ready with his trigger-finger, whose conduct is motivated by the feeling that the world is against him, and that violence is his refuge and his strength," observed the Danbury, Connecticut *News.*

The Clarksdale, Mississippi *Register* said, "The theory sounds reasonable. Keyed up to fighting pitch, these youngsters develop dispositions and viewpoints that make robbery and banditry and gunplay nothing more than outlets for nervous energy, relaxation from strain, adventure that acts as a counter-irritant to the noise!"

"Noise is not often mentioned in bills for divorce, but often it is the little devil that starts couples toward the divorce court," was the opinion of the Minneapolis *Star.*

The Wilkes-Barre *Record* said, "Children usually suffer from many fears, observes a psychologist, but only two of them are instinctive. These are the fear of falling and the fear of a loud, rasping noise. . . . However you explain it, it is well to remember these inborn fears, and safeguard children from them."

"And now comes Professor Dockeray of Ohio Wesleyan University with evidence that the noise of the city spurs the brain and stimulates the body. We keep going, he believes, on noise cocktails. But there is such a thing as over indulgence in cocktails," observed the Syracuse, New York *Journal.*

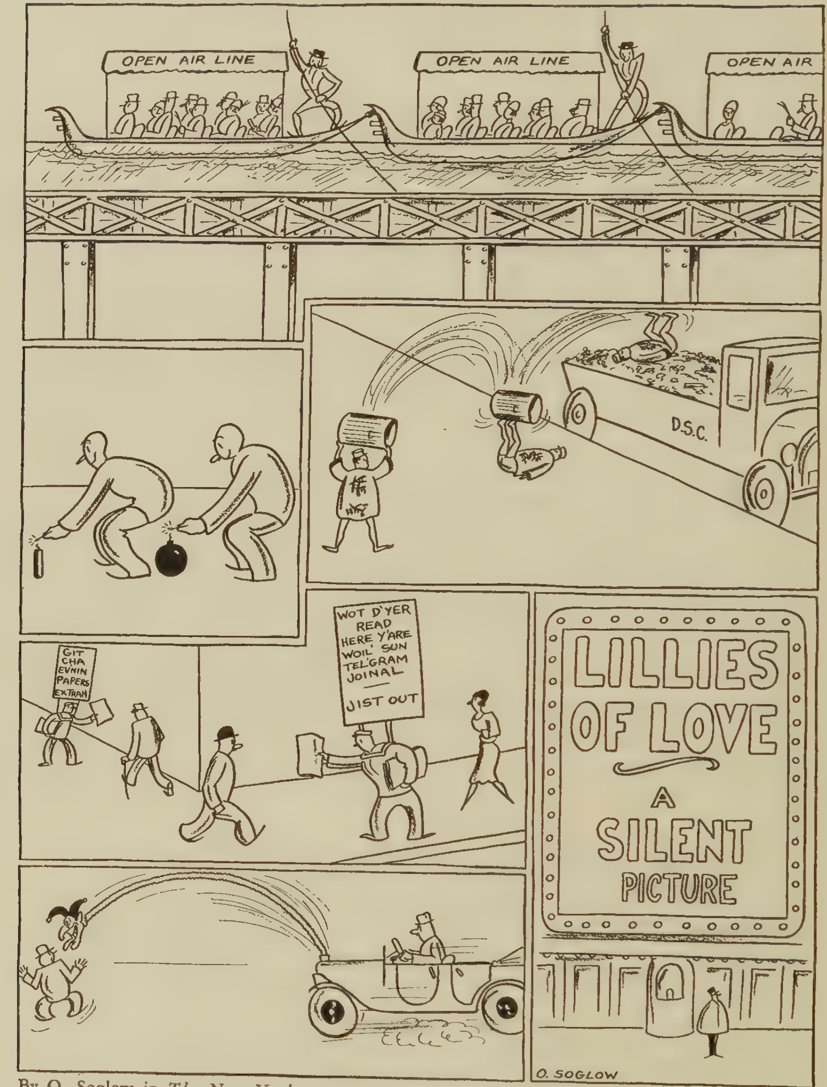
And the Detroit *Free Press* gives a subjective view of the same suggestion, "We don't know what an unmuffled motor truck explosion may do to case-hardened New Yorkers, but we know what it does to a good many brains in this part of the world. It creates intense, temporary homicidal mania which does not subside for several minutes. That isn't a joke either. Unquestionably city noises, both chronic and sudden, are the direct exciting causes of many violent offenses." "Here are a number of causes of unnecessary noise which could be corrected without any sacrifice of business, convenience or necessity," said the Dayton, Ohio *Herald.*

A New Code of Etiquette Needed by City Dwellers

The Dallas, Texas *News* remarked, "But it (noise) will be suffered until we Americans grow up. Invention and precaution will help some. But self-restraint and consideration for others are nine-tenths of noise abatement."

Said the New Orleans *Times-Picayune,* "The campaign against unnecessary noises will be a long one, for it must be educational." The Albany *News:* "The people can make their city quieter if they will, but they won't. . . Some day America, in self-defense, will unite its forces to mitigate the noises that are so common now." The Brooklyn *Standard-Union:* "Very likely the able com-

ABATING THE NOISE EVIL


OPEN AIR LINE
OPEN AIR LINE
OPEN AIR
D.S.C.
GIT CHA EVNIN PAPERS EXTRA!
WOT D'YER READ HERE Y'ARE WOIL' SUN TEL'GRAM JOINAL
JIST OUT
LILLIES OF LOVE
A SILENT PICTURE
O. SOGLOW

By O. Soglow in *The New Yorker*

mittee, along with its technical recommendations, will include some plan for the moral suasion of persons who enjoy producing noises other people don't like." The Cleveland, Ohio *News:* "Many of those who make useless noise would probably be the first to complain about it if they were to change places with those whom destiny has placed in the ranks of the disturbed listeners."

Said the Staunton, Virginia *Evening Leader,* "Education, general intelligence, is the best cure for all useless noises."

The New York *World* expressed the skepticism that such a large-scale plan suggests: "There remains the noisiness of tens of thousands of plain John Does and Richard Roes who can be corrected, in the last analysis, only by aroused public sentiment," while the Harrisburg, Pennsylvania *Telegraph* remarked, "Due regard for the rights of others and care in construction and operation . . . of modern devices will do more to stop needless noises than all the ordinances that may be passed." The Boston *Globe* agreed by saying, "Few persons will deny that noise is a nuisance. . . . The whole question simmers down to one of good community manners."

When Builders Feel Apologies are in Order

Carrying the idea of noise etiquette to the very extreme of all etiquette, the Irving Trust Company apologized to its neighbors for riveting noises made at its new building, 1 Wall Street. This apology set a precedent which was followed by the builders of the apartment house at 40 Gramercy Park. "For the second time since Commissioner of Health Wynne appointed his Noise Abatement Commission makers of noise have paused to apologize and then gone on with their noise," commented the New York *Times.* The Boston *Transcript* rallied with: "But such suggestions are of minor importance. The main thing is that noise has come to be regarded as something for which apology should be offered. The cities are growing ashamed of it. Therein lies hope that something really effective will be done to lessen it," while the New York *Post* considered the builder's apologies at best only a hopeful sign: "Whether or not these apologies are a step in the right direction we are not quite sure. They represent a friendly spirit but they don't help much. . . . We shall get into the habit of snapping back with cutting remarks to the effect that it is all right to say you're sorry, but how about doing something about it?"

The Need of Law

That etiquette must be backed up by law is the gist of many pertinent editorials. The Brooklyn *Times* asked, "When shall we have regulations moderating the noises of our thoroughfares?"

"It would be a ridiculous thing to punish a man for keeping a skunk farm to the windward of his enemy's house yet allow him to go scot free when he lets loose a hell of sound at his next door neighbor," remarked the Providence *News.*

The New York *Sun* commended the plans of the Commission: "In its report to the Health Commissioner the new Commission will have to blend the ideal with the practical; if it recommends new laws let them be laws that can be enforced."

The New York *Herald-Tribune* observed, "In this age of change even noises change. . . . There are hospital streets within the city which still bear signs enjoining drivers to walk their horses, though forty automobiles now snort past to one weary quadruped."

The Newark *Call* congratulated the Noise Abatement Commission on the sanity of its suggestions and added, "New York will become a quieter city if the recommendations of its Noise Abatement Commission are adopted, as they deserve to be. . . . Gotham's lawmakers would do well to accept the suggestions of the experts. What is more, Newark and other metropolises could profit by this example." But the New York *World* said, "The reduction of noise should be quite as practical as the reduction of smoke and could be accomplished in much the same way. . . . not so much law and not so much aroused opinion . . . but . . . some such body of officers as the twelve smoke inspectors."

Petty Fines for Minor Offenses

The suggestion of the Commission that the Charter be amended to establish a system of petty fines for noise offenses called forth varied comment:

The Philadelphia *Inquirer* said, "The recommendation of New York's Noise Abatement Commission for a schedule of fines varying with the nuisance created is based upon the theory that the punishment should fit the crime; . . . . The commission proposes to simplify the machinery of enforcement and to relieve the courts of petty cases by giving the police precincts the right to collect fines where the offense is admitted."

The New York *World* approved: "This creates what we have advocated all along: simple machinery by which citizens can obtain relief from noises as distinguished from the cumbersome, tedious, and usually ineffective machinery that obtains at present. All in all, it seems to us that the plan is admirably adapted to the problem, and should be put into effect."

The New York *Post* said, "In their suggested scale of fines for noise violators the members of the Noise Abatement Commission have shown great shrewdness."

The Dayton, Ohio *Herald:* "The commission's plan has merits. . . . Doubtless a system in which the needless noise maker would be required to pay for his thoughtlessness and lack of consideration would reduce the output and thus serve the interests of all citizens."

The Christian Science Monitor: "A recommendation of the Noise Abatement Commission in New York, whatever determined action to abate may or may not follow, will stir wide comment. The proposal would abate by pocketbooks. . . However, public recognition of the individual right to protection from unnecessary noise is a forward step. . . . Meantime the efforts of the Noise Abatement Commission will continue to win much silent applause."

The Minneapolis *Journal* said, "New York might try doing something to mitigate its major cacophonies first. But the New York idea is good at that. It is well worth considering in cities like Minneapolis, where minor noises may become very annoying." The New Orleans, *Picayune:* "Will the system work? It has for half a century in Germany, but that's a different land."

Said the Hagerstown, Maryland *Globe,* "The suggestion of the commission to assess fines ranging from 50 cents to $2.00 will make noise-makers stop and do a little thinking."

"At least, such fines, if rigidly applied, might pay a large proportion of our cost of local government," was the belief of the Meridian, Mississippi *Star.*

"It is the belief of the commission that the guilty will soon grow weary of the annoyance that paying repeated fines imposes," explained the Lancaster, Pennsylvania *New Era.*

The Traverse City, Michigan *Record Eagle* commented, "This novel plan looks workable. It names specific offenses and their penalties. It puts such offenses on a par with traffic violations. Other cities will watch New York's efforts with keen interest. Noise nuisances form a live problem everywhere."

Special Noises Receive Special Comment

Special noises requiring special treatment were recognized universally in the same ratio, not surprisingly, that they were listed in the questionnaires received by the Commission.

"The anti-noise movement has reached Philadelphia," said the Philadelphia *Record.* ". . . . A forced restraint upon selfish and stupid abuse of automobile signals and loud speakers would be an excellent beginning." The Salt Lake City *Deseret News* remarked, "Our well-known mechanical ingenuity and efficiency seem to have devoted themselves to the task of making noise in a superlative degree. . . . Some day there will be ordinances to restrict street noises." And the Dallas *Journal* added, "Inventive genius can do much to reduce to a minimum the noise of motors, street-car wheels, riveters and like offenders."

Automobile Horns

The automobile horn came in for due comment, the New York *Times* saying, "The fact that a gentleman from Vancouver should have seen fit to join with a visitor from Peking in deploring the habit of New York taxi-drivers of blowing their horns incessantly and raucously whenever they are blocked in traffic jams, serves to call attention again to a custom to which many New Yorkers—and all taxi drivers—have become tone deaf. The futility of the custom does not seem to have occurred to most drivers."

"Car drivers need education. . . . Civilization today is noisy enough without the incessant and irritating squawk of auto horns. Let every driver join in the movement to abate the nuisance," was the observation of the Madisonville, Kentucky, *Messenger.*

The Miami, Florida, *Herald* stated: "Automobile horns are of little use except in giving incompetent drivers an opportunity to advertise their lack of skill." And the Indianapolis *Tribune* declared, "The time would seem to be at hand when the public besides enjoying the comfort and perfection that mechanical devices have brought with the automobile should demand suppression of the nuisances incident to travel in taxicabs and buses."

"In the early days of automobiles, when the world was in the horse and buggy age, a horn was an absolute essential. Today, in most cases, it is used by drivers in lieu of brakes and thus it is not only annoying but extremely dangerous. . . . Car drivers need education in this regard. Civilization today is noisy enough without the incessant and irritating squawk of auto horns," commented the Ashland, Ohio *Times-Gazette.*

The Minneapolis *Star* said, "Norway is reported to be considering abolishment of the automobile horn. If horns were barred from cars in Minneapolis a good many automobile owners would have to put brakes on their cars."

While the Detroit *News* remarked, "Every time the matter is taken up of a nation-wide anti-noise campaign, someone comes out with a louder and funnier automobile horn."

"The young idiot who calls for his girl friend and is too lazy to go to the door and ask for her, but who sits from five to twenty minutes sounding his horn, is a pest who would meet quick and complete extinction if it were not for the laws against murder," was the heart-felt comment of the Danbury, Connecticut *News.*

Following Mr. Lewis H. Brown's radio talk in late December, many papers remarked on the suggestion for a softer-toned automobile horn. Said the Philadelphia *Inquirer:* "This idea of Lewis H. Brown, chairman of the New York Noise Abatement Commission, for an automobile horn which will dispense sweet harmonies upon the ambient air is the saddest and weakest proposal for capitulation to an unmitigated nuisance that we have heard in many months. . . . We are no more anxious to hear the medley of 'melody' horns than we are anxious to hear the combined harmonies of six overlapping broadcast stations when we tune in on the radio. . . . The public objection to automobile horns is the careless and needless sounding of these devices. . . . the impulse is to vent petty rage or impatience when traffic is blocked or delayed. . . . Automobile horns should be sounded only when there is need to avert actual danger."

The New York *Herald-Tribune* declared, "The inspection and amelioration of automobile horns undertaken by the Noise Commission is perhaps the most practical step which that body could have proposed. . . . When an inquiring citizen stood on a succession of street corners some months ago and made a census of necessary and unnecessary hoots from passing drivers he found more than 97 per cent of them totally useless. . . . At present the theory of automobile signals is to accomplish this recognition by means of loudness. . . . There is not only the disadvantage of annoyance to persons for whom the signal is not intended, but the even greater detriment that the loud noise often causes fright. In real emergencies . . . . the individual being warned will be far more competent to do whatever is necessary if he is not simultaneously scared to death. . . . The discriminatory abilities of the ear for differences in sound quality are far greater than differences in quantity. Two English words, for example, are distinguished with ease even when the difference between them is slight. The same word spoken in varied degrees of loudness is less easily discriminated."

The Brooklyn *Citizen* remarked gayly, "A carillion of millions of horns or bells, playing throughout the United States at all hours of the day and night, would create a sensation and convince the effete countries of Europe that America is indeed becoming musically minded."

And the Syracuse *Post-Standard* said, "In a few months of its existence, the commission has laid the foundation for an imposing structure of statistics. . . . But there can now well be the proposed specialization in the matter of the motor horn."

From the Athens, Georgia *Banner Herald* came the sympathetic statement: "The officials of New York City have set the pace for other cities to follow in the suppression of unnecessary blowing of horns and other devices attached to automobiles. . . .

Athens should fall in line with the large cities of the country in an effort to furnish every protection possible for pedestrians and autoists."

The South Manchester, Connecticut *Herald* spoke of the usual auto horn, "It has no business to adopt a tone indicating the conviction that the pedestrian is a worm and that the only reason for warning him is to keep his remains from mussing up the chassis."

"New York's Noise Abatement Commission pronounces the motor car horn 'the meanest noise in traffic.' Anybody who has a motor car horn blown down the back of his neck, while endeavoring to cross a Worcester Street, knows that New York's Noise Abatement Commission is absolutely right," remarked the Worcester, Massachusetts *Telegram.*

Super-Amplification of Radio Noise

Radio as an offender through the abuse of loudspeakers received much notice. "Something has got to be done about the radio corsair who forgets the health, the privacy and the sanity of all the rest of the world in his own blind and crazy devotion to the metallic blatancies of the horn," said the New Haven *Journal-Courier.*

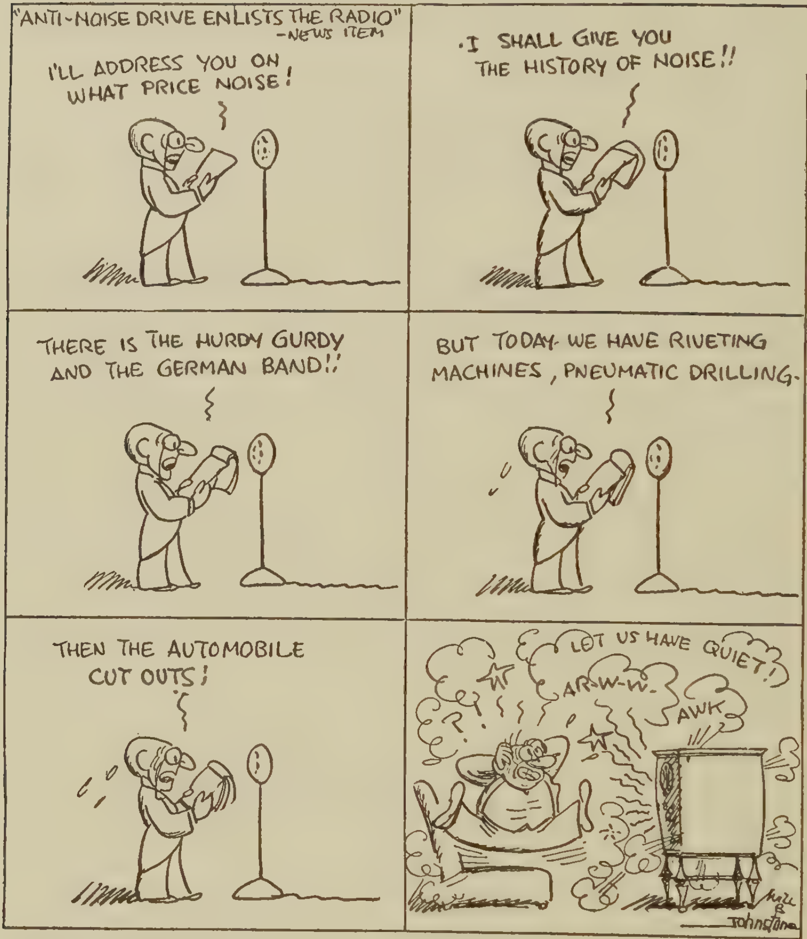
And the *Home News,* the Bronx, New York, remarked, "So we find again that the radio, that undoubted boon to humanity, is one of the worst of the contemporaneous pests when it is abused."

"Cantankerous radio is, in cities, one of the worst of all nuisances. It should be remembered that this noise business is serious, even in comparatively small cities," was the opinion of the Tulsa, Oklahoma *World.*

Concerning the Radio Ordinance

When the ordinance prohibiting the abuse of loudspeakers came up for consideration by the Board of Aldermen, the New York *Post* said, "Pass the anti-noise ordinance. If it were submitted to a referendum there would doubtless be an overwhelming majority in favor of the ordinance introduced by Alderman

QUIET, PLEASE!


"ANTI-NOISE DRIVE ENLISTS THE RADIO"
-NEWS ITEM
I'LL ADDRESS YOU ON WHAT PRICE NOISE!
I SHALL GIVE YOU THE HISTORY OF NOISE!!
THERE IS THE HURDY GURDY AND THE GERMAN BAND!!
BUT TODAY WE HAVE RIVETING MACHINES, PNEUMATIC DRILLING-
THEN THE AUTOMOBILE CUT OUTS!
LET US HAVE QUIET!
AR-W-W-
AWK
?
!
Johnstone

By Will B. Johnstone in *The World*

Stand restricting the use of sound-making or sound-reproducing devices. . . . Passage of the proposed ordinance should make it less difficult for adults as well as children to get a proper night's rest."

The New York *World* said, "There are many good reasons why the Board of Aldermen should adopt the ordinance introduced this week by Mr. Stand limiting the use of radio loud speakers on the streets outside of shops to special occasions, such as important national events, and requiring a permit from the Police Department for their operation at such times. The ordinance has the indorsement of the Noise Abatement Commission, formed last year by Health Commissioner Wynne, and is a carefully considered measure."

On the same subject, the Bronx *Home News,* Feb. 8, 1930, observed: "Such an ordinance has been needed urgently for several years and during all of that period the Home News had so expressed itself."

"There is an ordinance that a good many other cities might well copy. . . . A copy of that New York ordinance wouldn't be a bad thing for St. Paul," said the St. Paul *News.*

Duluth, Minnesota *Herald,* spoke of the local ordinance covering the same ground, "The city council did the right thing in passing the ordinance prohibiting the use of phonographs and radio loudspeakers for street advertising of such wares. . . . It wasn't so bad when one dealer began to turn loud music loose on people on the street; they could get away from it if their offices were not too close. But when many other dealers did the same thing and people walking along the streets paraded through a continuous blare and blat, it became a public nuisance."

When the series of talks by members of the Commission was broadcast over the radio, the Bronx *Home News* observed, "Thus it becomes clear what a wonderful invention the radio is. Picture, if you can, an appeal for less noise made by the means of a hurdy-gurdy or a pneumatic drill. It can't be done. But the radio, one of the most effective noise makers of history, can be employed in an effort to reduce the clamor, clatter, rattle, roar and racket to which the radio-listening public is subjected."

The First Fine

Commenting on the case against the radio dealer who persisted in operating a loudspeaker after the neighbors had asked him to be more considerate, the New York *Times* said, "The fifty-dollar fine imposed on the proprietor of a Bronx music store for operating a radio loudspeaker so as to give offense to his neighbors is the first case in which the new city ordinance to regulate obnoxious noises has been applied to broadcasters. . . . it shows that the new law can be made effective, and it holds the hope that other offenders may be coerced into showing greater regard for the rights of the people next door." And the New York *World* remarked, "The case is important, as it shows that people in other sections who are similarly annoyed can now get relief."

The St. Louis, Missouri *Globe-Democrat* said, "So the issue of fact as to whether a loud speaker may be an illegal noise-making instrumentality within the inhibitions of the ordinance is decided in the affirmative and becomes *res adjudicata.*"

The Beginning of Quieter Subways

The installation of silencers on subway turnstiles called forth only praise. "The anti-noise commission has another feather in its cap, with the installation by the Interborough Transit Company in New York subways of near-noiseless turnstiles," was the opinion of the *Christian Science Monitor.*

The New London, Connecticut *Day* said, "New York has succeeded in eliminating one of the worst rackets in the town. . . ," while the Yonkers, New York *Statesman* greeted this as a step of progress, saying, "New York seems to be getting somewhere with its campaign against needless noises." And the Boston *Post* observed cautiously, "It is to be tested whether it will stand up under the night rush. If it does, Boston can be well content to imitate New York and get rid of the present turnstiles which are unnecessarily nerve wracking."

"If turnstiles can be silenced in one place they can be silenced in others, and other sorts of noises probably can be silenced somehow or other. It is a large field for clever inventors," observed the St. Louis, Illinois *Journal.*

Assorted Noises

Speaking of the growing noise of airplane motors, the Columbus, Ohio *Citizen* observed, "There's only one real solution for the problem and that's to hasten the advent of silent airplane motors."

Trucks came in for general consideration and were mentioned more specifically by the New York *American* which said, "New York is the noisiest city in the world. . . . A strong drive to quiet down the motor truck would give impetus to the silencing movement, and in time we would have more restful conditions," and by the Chillicothe, Ohio *News Advertiser,* whose comment was, "Many drivers operate motor trucks and automobiles in a needlessly noisy way."

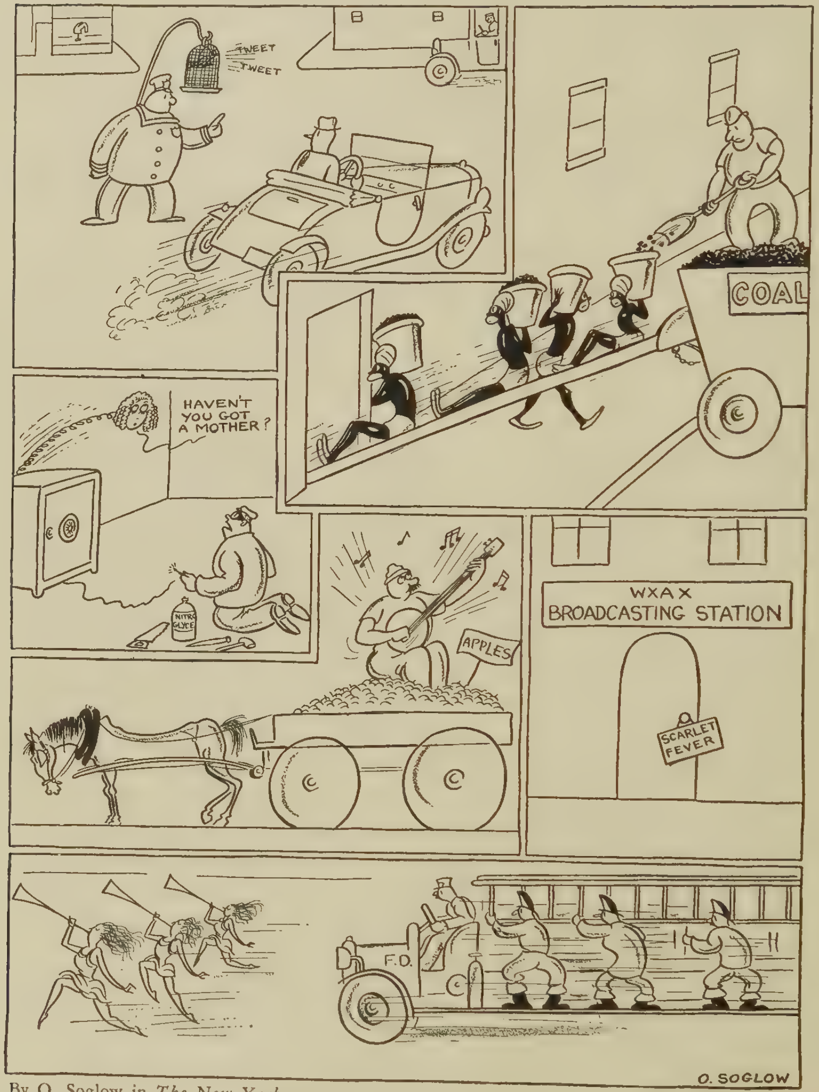
The Indianapolis *News* spoke of bus noise, "The sporadic improvement that has been noted recently in bus operation is a step in the right direction, but it is a short step and an uncertain one. For one thing, it depends too much on the driver. . . .For this reason it would appear that the ultimate remedy must be in engine readjustment."

The problem of general traffic noise was clearly defined by the Salt Lake City *Tribune:* "If traffic noises were confined to the congested areas of cities homebuilders might exercise a choice in the matter of residence, but since the noise has, to a large extent, invaded the residence sections, there appears to be no incentive to go far out for 'peace and quiet,' especially along the heavily traveled boulevards and avenues. . . .On the fringe of the business area, where apartments are generally built, the congestion of traffic, with its attendant noises, is quite as noticeable as in the business districts."

The Dayton, Ohio *News* mentioned riveting especially, "Health Commissioner Wynne of New York and his Noise Abatement Commission are up against one hopeless stumbling block—the skyscraper. . . .A war against noise which fails to conquer this major offender is pointless. New York must look to the wizards of welding," and the Clarksburg, West Virginia *Telegram* said, "Smaller communities can welcome it even more warmly. In the roar of big cities, the noise of a riveting machine is partially lost. In smaller places the din is more terrific."

The New York City *Post* observed at the time of the railroad and steamship conference called by Commissioner Wynne: "The amount of noise can be materially reduced. Its reduction depends simply upon the intensity of our determination to effect such reduction."

ABATING THE NOISE EVIL


TWEET
TWEET
B B
COAL
HAVEN'T YOU GOT A MOTHER?
NITRO GLYCE
APPLES
WXAX BROADCASTING STATION
SCARLET FEVER
F.D.
O. SOGLOW

By O. Soglow in *The New Yorker*

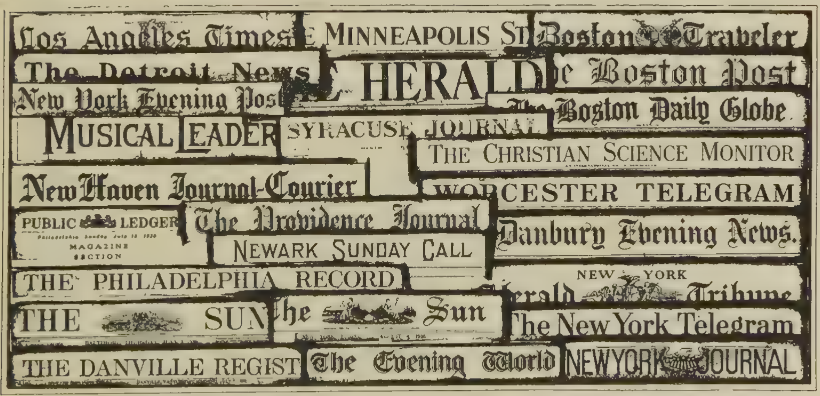
That noise is spreading even to the remotest vacation spots was the observation of the Augusta, Maine *Kennebec Journal*, which said, "The dwellers in congested places are victims of noise. . . .When seeking relief, especially during vacations, what is more natural than for the afflicted to seek the quiet places. But the once quiet places are fast becoming noisy during the summer months. The placid waters are no longer navigated by row and sail boats but by craft propelled by what sounds like machine guns, put, put, putting."

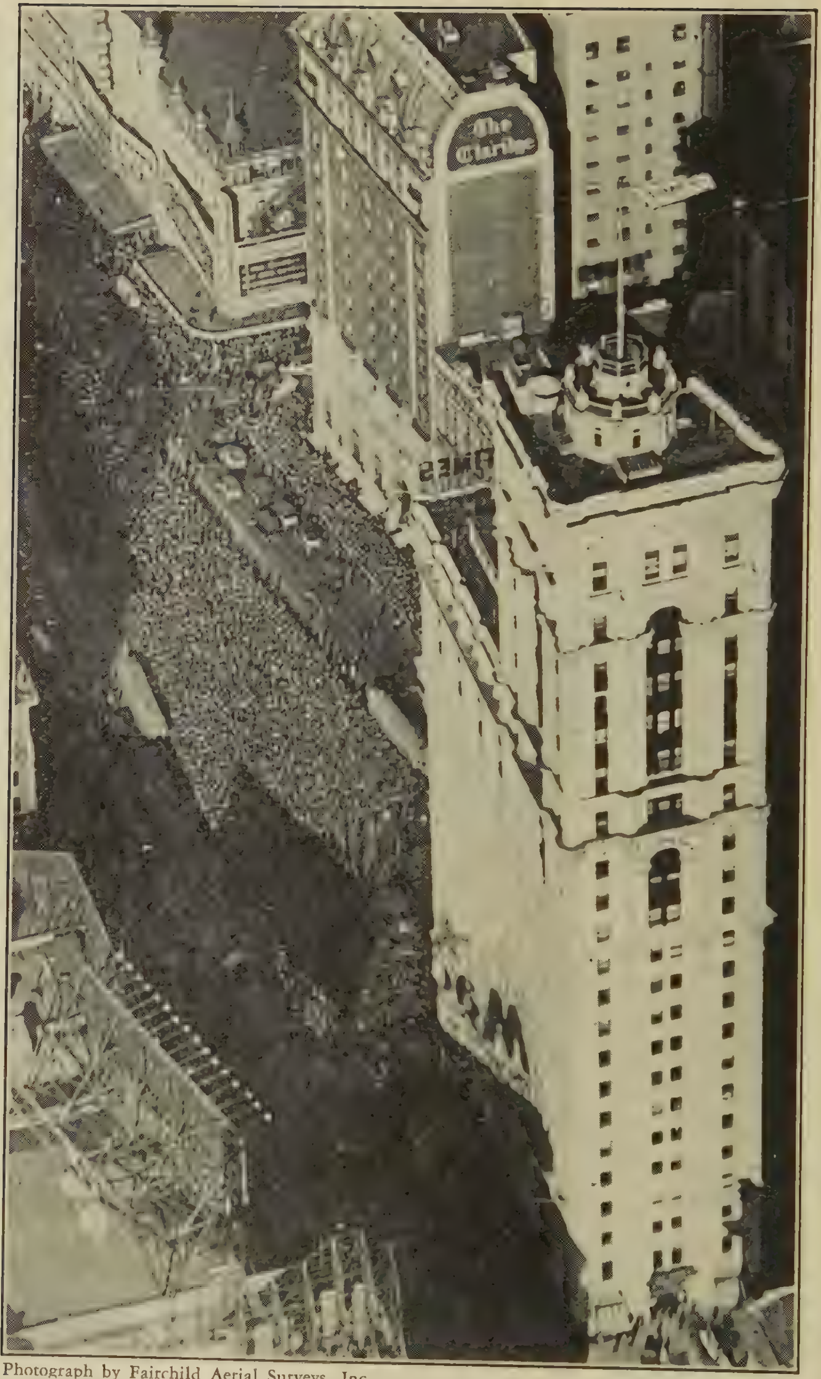
Looking Forward

The possibilities of a quieter metropolis appeal not only to those engaged in business and those seeking vacation quiet, but to educators, inventors, and men and women engaged in the various arts. Thomas A. Edison attributes to the quiet with which his deafness surrounds him much of his ability to think things through.

The *Musical Leader* remarked at the beginning of the campaign against noise, ". . . .when everyone's ear is not battered as vigorously as it is now, a great number of people who have been deaf to the beauty of music will experience an increasing sensitivity to its subtleties and may acquire an interest in the art."

Speaking of the way the New York Noise Abatement Commission has begun its attack on city noise, the Boston *Post* said, "To the credit of New York be it said that she has now the first anti-noise commission in the United States. . . .This is a real commission, not a pretense at one. . . .Whatever suggestions this initial commission may have to offer will be of great value."


Los Angeles Times
MINNEAPOLIS ST
Boston Traveler
The Detroit News
HERALD
Boston Post
New York Evening Post
Boston Daily Globe
MUSICAL LEADER
SYRACUSE JOURNAL
THE CHRISTIAN SCIENCE MONITOR
New Haven Journal-Courier
WORCESTER TELEGRAM
PUBLIC LEDGER
MAGAZINE SECTION
The Providence Journal
NEWARK SUNDAY CALL
Danbury Evening News.
THE PHILADELPHIA RECORD
NEW YORK
Herald Tribune
THE SUN
The Sun
The New York Telegram
THE DANVILLE REGIST
The Evening World
NEW YORK JOURNAL



Photograph by Fairchild Aerial Surveys, Inc.

City noise—complex as the city itself requires the attention of experts in many fields.

The Experts Report

* * *

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What Noise Does to Us

DR. BERNARD SACHS, *Chairman*
Committee on Effect of Noise on Human Beings

DR. SAMUEL J. KOPETZKY
DR. FREDERICK TILNEY
DR. FOSTER KENNEDY
DR. ARTHUR B. DUEL
DR. ALEXIS CARREL

THE purpose of this committee is not to study the effect of mere sound on the human system, but to report upon the harmful effect of noise upon the average inhabitant. We may accept Webster's definition of noise:

"Noise is a sound that is without agreeable or musical quality. Noise is either a sound of too short a duration to be determined like the report of a cannon, or else it is a confused mixture of many discordant sounds like the rolling of thunder or the noise of the waves."

That noise is harmful, is sufficiently evidenced by the feeling of annoyance it causes almost everyone and also by the fact that in many cities and in different countries the effect of noise has been seriously considered.

Thus in London, Robert Armstrong Jones states that city dwellers are neurotic—that sleep is indispensable to the neurotic, who does the work of the world—and the most disturbing noises to sleep are unusual and sudden horns, exhausts, drills, vibrations, whistles, milk cans.

The Noise Commission of London believes that preventable noise retards the efficiency of brain workers and to the other noises it adds that of barking dogs, street venders, careless milkmen, and whistling locomotives.

It also believes there is difference between street and industrial noises. Street noises are more injurious because they are non-rhythmical—the body cannot become adjusted to them, and they create tensions generating angry emotions, thereby adding to fatigue.

It further believes that neurosis may be attributed to noises just as in the case of shell shock. Similar observations have been made in Australia and in Canada, where the chief journal speaks of this as the "Age of Noise" and adds that unless something is done quickly to check the greater volume of sound that assaults our ears, we may find ourselves deprived of a capacity for sustained work, clear thinking, and energetic action, which is the mainstay of civilized life.

The reaction to noise also has been studied by Dr. John J. B. Morgan, of Northwestern University, who summarizes the experiment made on 50 men and girls who were reading a paragraph. When a noise is introduced there is an increased articulation on the part of the subjects in the attempt to keep their minds on their work. This increased articulation causes an increase in breathing; with the increase in breathing and articulation, the speed of the reader decreases.

The effect is also noticed as the reaction to noise of subjects working on a typewriter. A noise was introduced and the pressure of speed and accuracy of the work compared with that done in silence was reported as follows, "The keys were struck with greater force during the noise." But the experiment was so arranged that the extra tension was not one due to voluntary effort to overcome the noise.

The reaction of infants to various tones has also been studied. While tones of very low frequency and low intensity may produce positive signs of discomfort, other auditory stimuli cause positive manifestations of discomfort.

Morgan summarizes his findings by saying that overcoming noise while working requires extra effort. There are some noises which are seemingly more disturbing than others and, in the elimination of noise, those of high frequency should be especially considered.

Poffenberger believes that Morgan judges the effect of noise too mildly simply because efficiency is not markedly decreased by noise. And he adds that the ill effects of noise did not show themselves right away because people never work up to their full capacity.

There is very little use in going into minute psychological experiments on this question; as medical men we are willing to plead for the elimination of or diminution of as many noises as possible on the ground that:

First, hearing is seriously threatened by continuous loud noise.

D. Tucker of London says that the ear can accomodate itself to states corresponding to all displacements from one to ten million in magnitude. The equipment of the ear makes it continuously adaptable to London traffic unless all these sounds merge, which they do not, therefore the portion of the ear which controls adaptation gets no rest.

Second, after a certain frequency of loud and recurrent noises, the accommodation muscles do not react. This lack of function due to noise leaves a breach in the protection of the ear and accounts for some of our fatigue at the end of the day.

Third, it is not the steady roar of the traffic, but its various noises which impose the chief strain on the ear.

Fourth, Wittmaack has proved that some auditory organs are completely destroyed by prolonged exposure to loud noise, and he sees in this the positive development of deafness which often begins with an inabiilty to distinctly recognize tones.

Another British author is very certain that occupational deafness is well known, and that as our cities become noisier there will be more occupational deafness among printers, omnibus drivers, road breakers, and traffic policemen.

Here in New York this observation can easily be substantiated. Our automobile and taxi drivers are becoming hard of hearing and the same is known to be the case among boiler workers and other laborers or mechanics exposed to a constant riveting noise.

At Bellevue Hospital, Dr. Kennedy, of this committee, has begun a series of experimental tests to acertain the effect of sudden noises on blood pressure, heart rhythm, and brain pressure.

It does not seem practicable to obtain valuable experimental information on the effect of continued noises but one may legitimately deduce the effect of continuous noises on the human organism from the results obtained by noises that occur suddenly. These experiments are being carried out by the electro-cardiograph, the blood pressure apparatus, and by especially devised apparatus to determine the pressure within the skull.

Patients are being employed who for one reason or another, have a large defect in the bony covering of the brain. On these soft areas a drum, containing a partial vacuum, is placed. Vibrations from it are communicated to a sensitive needle acting on a revolving drum. In this way the pulsations of the brain have been graphically registered. A blown-up paper bag was then burst by the hand, behind the patient's back. A notable rise in inter-cranial pressure was at once registered on the moving drum. For some minutes afterwards the inter-cranial pressure was irregularly disturbed and raised. A second noise produced a second peak in the curve.

These original graphs will be collected and passed to the commission with appropriate comment.

But aside from the effect which constant noise has upon many individuals and especially upon their hearing, the abatement of noise is imperatively needed because it interferes with sleep. No argument is needed to the effect that every individual needs between six and nine hours of sleep. The vast majority are accustomed to take sleep during the night and for that reason, at least, the hours from eleven to seven should be, so far as possible, entirely free of distressing noises. Growing children, many invalids, and all convalescent patients are in need of extreme quiet during the day. Add to this the fact that many night workers, such as nurses and printers have to obtain sleep during the day and we have another strong argument for the elimination of noise whenever possible. All street noises are indirectly harmful, because windows have to be closed and thus both the sick and the healthy breathe more vitiated air than they would if windows were kept open.

The noise of the streets interferes with attention and concentration. It makes the task of teachers and pupils more difficult. It is a far call from the days of Schopenhauer, whose chief complaint was of the intolerable noise made by the cracking of the whip as careless drivers passed through the streets, which interfered with the thoughts of man, to the present day of innumerable and intolerable noises of our many automobiles, elevated trains, and, above all, of our riveting and excavating machines.

Your committee finds that the harmful effect of noises is shown in many ways:

1. Hearing is apt to be impaired in those exposed to constant loud noises.

2. Noise interferes seriously with efficiency of the worker. It lessens attention and makes concentration upon any set task difficult.

3. In the attempt to overcome the effect of noise, great strain is put upon the nervous system, leading to neurasthenic and psychasthenic states. Because of the incessant noise of the city, quiet needed for recuperation has to be sought in the country.

4. Noise interferes seriously with sleep, even if a few become tolerant. All noises, on streets and within doors, should be minimized during the sleeping hours (11 P.M. to 7 A.M.). Day noises interfere with the innumerable convalescents in hospitals and in private homes throughout the city, and with those like night nurses, typesetters, and others who are compelled to get their sleep during the day.

5. It is a well established fact that the normal development of infants and young children is seriously interfered with by constant loud noises.

Noise Measurement

Dr. Harvey Fletcher, *Chairman*
Committee on Noise Measurement Survey

Professor Albin H. Beyer
Dr. Arthur B. Duel

At the first meeting of the committee, held on November 7, 1929, its purposes were outlined as follows: (1) The general city noises will be measured and tabulated to furnish a basis of comparison for any future condition of supposed improvement or deterioration. (2) The magnitude of noises from specific sources will be measured to furnish a basis for recommendations for improvement.

Although some survey work had been done previously, it was agreed that the results available were inadequate, so a complete noise survey was undertaken to measure out-of-door noise in the city. For this purpose, a motor truck with apparatus and a crew of observers was sent throughout the city during the period from November 1929 to May 1930. The results of this survey were reported by Dr. R. H. Galt in a preliminary report dated March 21, 1930, already submitted to the Commission, and in a final report dated June 18, 1930, which is attached. As will be seen from this report, the noise levels were measured at 97 different outdoor locations in New York City. The average noise levels at these locations ranged from about 45 decibels to about 80 decibels. At each of these stations the noise levels varied up and down through a range of about 20 decibels. The highest level encountered in the streets was 101 decibels, which was due to a riveter 35 feet away from the measuring instrument. The minimum level obtained was 38 decibels, in a residential section at 4:30 A.M.

It is particularly interesting to note that the average noise levels taken over a 5 to 10 second interval vary more in a 20 minute period than the levels averaged over a 20 minute interval vary in a 24 hour period. For example, the 20 minute averages taken at 48th Street near 8th Avenue varied from 53 to 63 decibels, or a variation of only 10 decibels, during the 24 hour period, while the small interval average varied usually more than 20 decibels.

It will be seen from the results that the intensity of the noise due to street traffic is directly proportional to the number of vehicles of a given kind passing in a given time. In most cases the outdoor noise is principally due to traffic, so if one knows the number of passenger automobiles and the number of trucks passing per minute it is shown how one can estimate the noise level. This should be useful when desiring to reduce the noise in any locality below a definite level.

The noises from some of the specific sources studied produced maximum levels as follows:

MAXIMUM NOISE LEVELS FROM SPECIFIC SOURCES

Hammering on steel plate (almost painful)	113	decibels
Automobile Horn	102	"
Riveter	101	"
Subway	97	"
Blast of Explosives	96	"
Steamship Whistle	94	"
Elevated Train	91	"
Motor Truck	87	"
Lion Roaring	87	"
Steam Shovel	86	"
Police Whistle	83	"
Street Car	83	"
Passenger Automobile (noisy)	83	"
Radio Loud Speaker	81	"
Thunder (1 to 3 miles)	70	"
Passenger Automobile (quiet)	65	"
Church Bells	61	"

Through the courtesy of the joint subcommittee on Development and Research of the National Electric Light Association and the Bell System, the results of their work on indoor noises were communicated to the Noise Abatement Commission by the chairman, Mr. O. B. Blackwell. Attached is a report, dated June 13, 1930, by Mr. R. S. Tucker which gives a report of this work as it pertains to New York City. The noise was measured at 70 indoor locations. As will be seen from Fig. 1 of the report, the range of noise levels averaged over about five minutes found in business offices, factories, department stores, etc. was from 32 to 72 decibels, while in residences it was from 22 to 45 decibels. In general the noise level in a third story room facing the street is about 10 to 15 decibels lower with the windows open, and 20 to 25 decibels lower with the windows closed than that on the street, when the street noise is the predominant source. However, in the majority of cases it was found that the predominant noise arose from sources inside rather than outside the room. One of the specific sources of noise, which was studied in some detail in the measurements conducted by this committee, is the automobile horn. A report dated June 20, 1930, by Dr. J. C. Steinberg gives the results of this investigation. Thirty-three different types of automobile horns which were sent in by various manufacturers were tested for noise level, and a frequency-intensity spectrum was obtained for the sound emitted by each. The noise levels produced at 23 feet ranged from 70 to 102 decibels, the average being 90 decibels. Judgment tests were made also, both with respect to the objectionableness of the horns for such reasons as "frightening effect," "harsh or raucous tones," etc., and with respect to their ability to override noises simulating street noise in New York.

It appears that 42 per cent of the horns are louder than is necessary to override the loudest average noise levels existing on New York streets, 45 per cent had about the right loudness, and 13 per cent were not loud enough. The louder horns were judged to be very objectionable. The sound waves of all the horns are made up of fundamental frequencies and overtones, of different intensities. The sound waves for the most objectionable horns—motor driven type—had both harmonic and inharmonic overtones; those for the least objectionable horns—vibrator type—had harmonic overtones only. In most cases, the presence of inharmonic overtones causes the sound to have a "harsh" or "raucous" character.

The results of noise measurements contained in the attached reports are not to be regarded as exhausting the field of valuable noise studies. From more extensive investigations of specific noise sources and conditions, much might be learned of practical value in noise abatement. The committee has attempted merely to collect enough data to attain in a broad way its original objectives, and thus to establish a sound basis for the estimation of future changes in noise conditions and for immediate recommendations which are made as follows:

Recommendations Concerning Noise Out-of-Doors

1. AUTOMOBILE HORNS

I. The level of the emitted sound at the reference distance of 23 feet should be about 88 to 93 decibels. Levels in excess of this are unnecessary and objectionable. Levels less than this are insufficient to override the noise due to heavy street traffic.

II. Fundamental frequencies between 200 and 300 cycles per second appear satisfactory. The overtones should be harmonics of the fundamentals. The energy should preferably be distributed approximately uniformly in frequency, with just enough energy in the higher frequency ranges to secure directive properties. A relatively large amount of energy in the higher frequency ranges causes the sound to have a sharp and disagreeable character. The presence of inharmonic frequencies in the sound wave causes the sounds to have a raucous character.

III. Since an automobile horn must produce a rather loud sound in order to be useful as a signalling device, the use of horns should be severely restricted. In particular, the sounding of the horn should be prohibited when an automobile is one of a large number blocked in the street.

2. TRAFFIC CONTROL

Since the volume and the composition of street traffic largely determine the out-of-door noise at any particular place, all efforts should be made to keep traffic volume down and to restrict the type of traffic to that of the least noisy character. This can be done by traffic laws, by restriction of building heights to keep down congestion, and by multiplying thoroughfares. If it is particularly important to have quiet in a certain neighborhood, for instance near a school, a hospital, or a court, traffic should be so routed in that section of the city as to reduce the volume to a minimum in the immediate neighborhood under consideration and to keep commercial traffic away.

3. AUTOMOTIVE VEHICLES

Other than horn sounds, the noises produced by a motor truck, bus, or automobile are due chiefly to engine, gears, brakes, chains, tires, and rattling loads; of these the engine exhaust is generally the most noisy. Adequate mufflers should be required, and the use of muffler cut-outs should be prohibited in the city. Power should be transmitted by gears, not by chains. Loose frames, windshields, tailboards, and loads should be prohibited. The noise of changing gears should be reduced. For the present, the goal should be to make motor trucks as quiet as the present passenger automobiles, and to keep all automobiles as quiet as the less noisy half now are. These improvements could be attained by the proper construction, care, inspection, and use of the vehicles and would reduce the average street noise level at most places in the city by 5 to 10 decibels.

4. ELEVATED AND SURFACE ELECTRIC LINES

From the standpoint of noise on the street, elevated lines should be replaced by subways, and surface street cars by buses. These changes would reduce the maximum noise at most places on the streets involved by 7 to 10 decibels, and by 2 to 3 decibels, respectively.

The noise produced by an elevated train or a surface car may be reduced appreciably by so constructing the rails and rolling stock that sudden jolts and impacts are eliminated. A street car passing over a track crossing causes a noise about 6 decibels greater than that for ordinary track; and a street car moving fast over ordinary track causes about 7 decibels more noise than does a similar car moving slowly over the same track. Street cars should not be allowed to move rapidly over track crossings, and no crossings should be located in the immediate vicinity of a hospital or a school.

5. STREET SURFACE

Since the noise due to a horse-drawn vehicle on an asphalt street was found to be about 12 decibels less than that for a street paved with cobblestones, a great improvement will result from the introduction of proper street surfacing in districts where horse-drawn vehicles are numerous.

By careful and constant repair, street surfaces should be kept free from irregularities which cause jolts to passing vehicles.

6. OTHER SOURCES OF NOISE

All vehicles, wagons, trucks, and carts, whether propelled by motors, drawn by horses or pushed by hand, should be provided with rubber tires, which should almost universally be pneumatic.

The ordinance already passed restricting the use of loud speakers on streets should be enforced; and attention should be given to loud speakers in homes which disturb persons living nearby.

The measurements indicate that the noise from a boat whistle in the harbor frequently attains such a level that conversation is interfered with in rooms as much as a quarter of a mile distant. A noise of this intensity occurring at night will often interrupt sleep. It should be possible to mitigate this nuisance by restricting the duration and the frequency of occurrence of whistle blasts; and it is not unlikely that measurements of the sound intensity required for proper signalling by boat whistles in the harbor would indicate that reductions of 10 decibels or more could in many instances be made. If the sound levels now caused by boat whistles are necessary under sea-going conditions, provision should be made for producing lower levels in the harbor.

Although the riveter as a source of street noise is less frequent and usually more remote than the motor vehicle, nevertheless the noise of riveting proved by measurement to be one of the most intense found in the survey, and it is generally recognized as one of the most annoying in type. Moreover, when a building is being constructed close to an occupied building, the occupants of the latter may for a considerable time be subjected to an extremely intense noise from a source much closer than the riveter usually is to the street. Consideration should be given to the possibility of reducing the radiated sound by mechanical or acoustical damping, and to the possibility of replacing riveting under some or all conditions by electric welding.

Considerable reduction of the high noise levels measured for steam operated pile drivers, shovels, and other machines used in construction and excavation should result from the substitution of electrical power for steam.

Adequate mufflers would largely remove the noise produced by stationary engines of the explosive type, such as are used in air compressors, pumps, etc.

7. NIGHT NOISES IN RESIDENTIAL SECTIONS

The audibility of a noise, and hence its annoyance, depends upon the background of other noises. The measurements indicate that this background level on a busy street by day may be 35 decibels greater than on a residential street at night; hence a noise which during the day might be inaudible on a busy street may be very disturbing at night in a residential district. Noise restrictions should therefore be far more severe in residential sections of the city at night than in the entire city by day. Since noise sources are less numerous at night, such regulations will restrict relatively few activities.

8. POLICE DUTY AT NOISY LOCATIONS

In view of the extremely great noise at certain locations such as at the intersection of Canal Street and the Bowery, consideration should be given to the length of hours of duty for policemen at such places.

Recommendations Concerning Noise in Buildings

1. CHARACTERISTICS AND PLANS OF BUILDINGS

By proper treatment of wall surfaces and spaces between walls, and by proper selection of room furnishings, the transmission of sound may be reduced and its absorption increased. To diminish the cost, such treatment should, if possible, be included in the original designs.

To isolate noise, subdivide places of work; for example, have several one-desk offices rather than one office with several desks. Glass partitions should extend to the ceiling. Special rooms should be provided for conferences and interviews. Manual workers should be kept away from thinkers; computing machines and typewriters should be in different rooms from desk workers. Noisy factory operations should be segregated from others.

Windows and ventilators should be so designed as to reduce sounds coming from without.

2. TREATMENT OF INDOOR NOISE SOURCES

In addition to isolation, already mentioned, indoor noise sources may in many instances be quieted by improvement in design, with especial consideration of noise. For example, the exposed surface of rotating parts in electric motors may be made less irregular, reducing the motor whine; electric fan noise may be reduced by proper motor selection and blade design; impact of metal parts in machines of many types may be eliminated. The communication of vibrations from machine to walls, shelves, and other effective sounding boards may be reduced by mounting machines upon massive, disconnected pillars, and in some cases by absorptive pads.

Noise Survey of the City of New York
Report of Street Noise Measurements

I. *Introduction*

At the start of the survey, two principal objectives were assigned: to obtain a quantitative measure of the outdoor noise of New York; and to determine the major sources of intense and prevalent outdoor noises, and to measure and analyze the contribution of each source.

It is considered that these objectives have now been attained. The extent to which this has been achieved will be made clear by this report, which presents in greater detail the results summarized in the preliminary report of March 21, 1930, and includes certain later measurements. The results remain substantially as given in the preliminary report; but it has been possible to incorporate an improvement in the interpretation of the noise meter measurements, based upon recent laboratory tests, which indicate that the entire scale previously employed in reporting data should be shifted slightly. By this change, for example, a noise level given in the preliminary report as 72 decibels is now given as 70 decibels, the entire scale of levels as measured by the noise meter being reduced by 2 decibels. The measurements of deafening remain unaltered.

II. *Extent of the Survey*

Noise measurements have been made at 138 stations in the City of New York, distributed as shown in the following table:

TABLE 1

Borough of	Locations Out-of-Doors	Locations Indoors & In Subways	Repetitions	Total Stations
Brooklyn	8	0	0	8
Bronx	9	1	0	10
Manhattan	75	8	32	115
Queens	5	0	0	5
Grand Total	97	9	32	138

The 97 outdoor locations represent a wide range of noise conditions, from the quiet of a remote residential street to the din of the main highways; a wide range of traffic conditions, from no traffic to 129 automobiles per minute; and a wide range of geographical conditions, from the open terrain of the campus of New York University to the shut in canyon of lower Broadway.

Measurements were made near excavation and construction work; in a subway; beside elevated lines; on a bridge over East River; on the pier and simultaneously in an office when the whistle of a departing steamship was blown; on the streets near two schools and two hospitals; in rooms of a hospital and of a place of business, and on the adjacent streets; on "Radio Row;" and under other special conditions.

Most of the measurements were made between the hours of 9:30 A.M. and 5:30 P.M. At each of three locations, however, tests were made at intervals throughout a period of twenty-four consecutive hours.

Of a total of about 10,000 observations out-of-doors, 7,500 indicate the aggregate effect of all sources of noise at the particular place and time, without isolation of specific sources of the noise; in about 2,500 cases, not only was the measurement recorded, but the source of the noise was identified. Thus in about 200 instances the noise due to a motor truck was measured; the sound of a police whistle was measured about 60 times; of an automobile horn, 80 times; of squeaking brakes, 10 times; and so forth. Altogether, the noise produced by each of about thirty individual sources was thus measured, at stations widely distributed over the city. In addition, some hundreds of observations were made upon specific sources at especially chosen stations of a less general character.

At several stations the aggregate noise from many sources was subjected to a frequency analysis by means of band-pass filters. The same process was applied to the noise from each of several separate sources.

The measurements at most of the stations indicate not only the intensity of the noise, but also its deafening effect upon the human ear, in three different frequency regions. Among other results of these auditory observations, it is possible to specify the intensity which a policeman's whistle or an automobile horn must attain in order to be audible in the loudest traffic noise, or in average traffic.

A special study of automobile horns, from the standpoint of

Photograph by *Bell Telephone Laboratories*

Two methods of measuring noise were used as a check on each other—the audiometer on the left measuring the "deafening" effect and the noise meter on the right recording the noise level directly in decibels.

their effectiveness and desirability as acoustical signalling devices in traffic, has been described in another report.[1]

III. *Apparatus Used In Noise Measurements*

The measuring apparatus used in the survey consists of two instruments, a noise meter and an audiometer, the former yielding a purely physical measurement, the latter a measurement which involves the organs of hearing of the observer. The action of the noise meter, of which a simplified diagram is given in Figure 1, starts with a microphone which picks up the sound wave in the air and produces an electrical counterpart of it; the electrical wave is then amplified and rectified, finally operating a meter and causing the pointer or needle to move along the meter scale to a point determined by the intensity of the sound wave.

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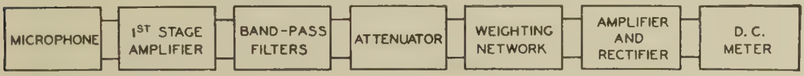
[1] "Report of Measurements on Automobile Horns," by J. C. Steinberg, appearing in this volume.

NOISE METER

Fig. 1



As Figure 1 shows, the noise meter is supplied also with an attenuator and a weighting network. The attenuator enables the observer to control the amplitude of the electrical wave by large steps, so that when a very loud sound is encountered, which would drive the needle off the scale of the meter, a known amount of attenuation may be inserted, bringing the needle back on the scale. The weighting network is designed to render the noise meter more sensitive to those single frequencies to which the human ear is more sensitive, and vice versa, so that the pitch of a tone will automatically affect the meter in the same way in which it affects the ear; while this reproduction of the action of the ear is by no means complete, owing to the very complicated characteristics of the ear, it represents an improvement upon any arrangement which neglects the ear entirely. The relative attenuation introduced by the network at various frequencies is approximately as shown in Figure 2, which is based on the curve of equal loudness of the normal ear at a sensation level of 30 decibels.[2]

In addition to the parts already mentioned, the noise meter contains a set of band-pass filters shown in Figure 1, any one of which may be omitted from the circuit, or inserted, by throwing a switch. The action of such a filter is to suppress any wave of which the frequency, or pitch, does not lie in the particular frequency region passed by the filter. One filter passes only waves of low pitch, having frequencies less than 500 cycles per second; another passes only the region, or band, from 500 to 1500 cycles; a third filter passes the band from 1500 to 3000 cycles; the fourth passes all frequencies above 3,000 cycles. In most of the observations of the survey, these filters were not employed, since the aggregate noise level was usually the quantity to be measured, rather than the amount of noise associated with some particular frequency band. Under some circumstances, however, it was desired to know how a complex noise was made up of the various simpler components; whether the pitch was predominantly high or low; and so forth. For such measurements the filters were employed, with results to be given later.

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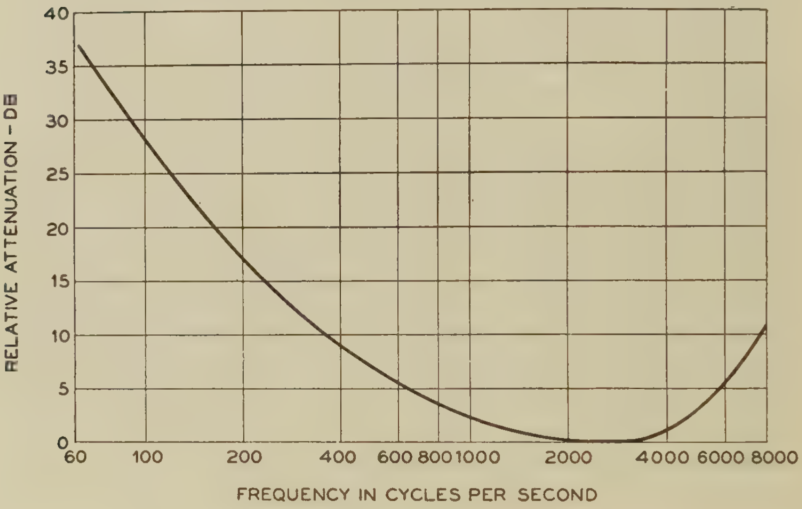
[2] H. Fletcher, "Speech and Hearing," p. 230.

SINGLE FREQUENCY CHARACTERISTIC OF NOISE METER WEIGHTING NETWORK BASED ON EQUAL LOUDNESS CURVE FOR NORMAL EAR AT 30 SENSATION UNITS *Fig. 2*



Attention should be called to one additional feature of the instrument, the time constant of the noise meter. When a noise begins suddenly, rising at once to a certain intensity and then remaining steady, the indicating needle of the noise meter does not instantly move to a steady position, but rises gradually, requiring two seconds to reach approximately a steady position, for one instrument used, and five seconds for another instrument. When the noise ceases, the needle takes a similar time to settle back to zero. Consequently, if a noise fluctuates rapidly and repeatedly, varying from a low level to a high level and then down and up again, as outdoor noises often do, the noise meter needle will not follow the noise level exactly, but will round off the peaks and valleys. The range of noise levels actually occurring will thus often be greater than the range of noise meter readings. The discrepancy is greatest when an isolated noise maximum or minimum occurs of very short duration, as for the noise due to an explosion, and becomes negligible when the maximum or minimum is sustained over a period of two to five seconds or longer, as for the sound of a passing elevated train.

The audiometer employed in the survey to measure the deafening effect of noise has been described elsewhere.[3] The instrument contains a phonograph which produces a test tone of the type usually termed a warble, the pitch varying rapidly up and down through a certain interval. Three such tones were used, one of low pitch, one of middle pitch, and one of high pitch. The phonograph produces each warbling wave, in turn, electrically; the electric current passes through a control or attenuator and is applied to a receiver held at the observer's ear. By means of slots in the receiver cap, the noise is admitted to the ear, as well as the test tone from the receiver diaphragm. The observer then adjusts the attenuator until the test tone is just audible in the presence of the noise. From this setting of the attenuator, and from a similar setting made in the laboratory in a noiseless room, the observer can tell how much his ear was deafened by the noise, for each of the three test tones. If a plot is made showing the amount of deafening plotted against the frequency characteristic of the test tone, the resulting curve is termed the audiogram of the noise.

IV. *The Decibel Scale of Noise Levels*

In ordinary conversation, a noise is often described as loud, or intense, with no attempt to state exactly how loud, or how intense, it is. When a more exact statement is required, the ordinary person will describe a noise as more intense than some other well-known noise. This method of describing by means of a comparison is the basis of the decibel scale which is used in reporting the noise measurements of the survey.

The comparison is made between the noise in question and the least intense noise which can be heard in a quiet place. Imagine a group of persons in a noiseless place, each individual holding a sheet of paper in his hand. Let us suppose that if one person alone rattles his paper the sound is just audible; this sound is said to be at threshold intensity. Then if ten persons rattle their papers, the sound will be ten times as intense as the threshold sound; if twenty persons rattle their papers, the sound will be twenty times as intense as the threshold sound. On this basis, a scale could conceivably be contructed such that the number of units would always be increased by ten if ten additional persons in the group rattled their papers. Such a scale, however, would involve certain difficulties which may easily be understood. Suppose, for instance, that ten persons are rattling papers; the addition of ten more persons would beyond doubt produce a considerable increase in the noise; whereas, if at the start a thousand persons were causing the noise, the addition of ten more persons would not be noticeable. It scarcely seems proper, therefore, to ascribe always the same importance to an added ten persons. A more fair estimation would be to consider what per cent is added; if we add ten persons to an original ten, we have added 100 per cent of the original number, and the noise level has been increased by a certain number of units; then if we start with a thousand persons and add another thousand, we have in this case also increased the number of persons by 100 per cent, and hence may say that the noise is increased by the same number of units as in the former case.

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[3] Journal of the Acoustical Society of America, Vol. 1, Oct. 1929, p. 147.

A scale constructed in this manner is illustrated by Figure 3. The scale on the right shows what may be thought of as the actual number of sources of noise—for instance, the number of persons rattling papers— the scale number on the left, marked decibels, is arranged to change by the same number of units, every time the scale number on the right is multiplied by ten. A scale difference of 10 decibels thus corresponds to a factor of 10 in the intensity scale. On the decibel scale, the unit is actually about equal to the smallest change which the ear can detect in the power level of a sound.

More accurately, the decibel is defined as follows: if the intensities of two sounds are in the ratio 10:1, the sounds differ in level by 10 decibels; if the intensities are in the ratio 10^2:1—that is, 100:1—the sounds differ by 20 decibels; and in general, the number of decibels measuring the difference in level between two sounds is ten times the common logarithm of the intensity ratio—that is, the power ratio.

RELATION BETWEEN
THE DECIBEL SCALE OF NOISE LEVELS
AND
NOISE INTENSITIES

Fig. 3

DECIBELS	INTENSITY AS A MULTIPLE OF THRESHOLD INTENSITY		
100	10^{10}	=	10,000,000,000
90	10^9	=	1,000,000,000
80	10^8	=	100,000,000
70	10^7	=	10,000,000
60	$10^6 = 10 \times 10 \times 10 \times 10 \times 10 \times 10$	=	1,000,000
50	$10^5 = 10 \times 10 \times 10 \times 10 \times 10$	=	100,000
40	$10^4 = 10 \times 10 \times 10 \times 10$	=	10,000
30	$10^3 = 10 \times 10 \times 10$	=	1,000
20	$10^2 = 10 \times 10$	=	100
10	10 = 10	=	10
0	1 = THRESHOLD INTENSITY	=	1

In this report, any noise level is expressed simply as a certain number of decibels. This means decibels above the threshold of hearing. Thus when the noise level at a place is given as 60 decibels, the intensity of the noise is 10^6 times—that is, one million times—the least intensity which the normal ear can hear.

The decibel is used also in measurements of the amount of deafening produced by a noise. Thus the noise at a particular street corner may cause deafening of 60 decibels; this means that a sound which is just audible at that place is more intense by 60 decibels than a sound of the same type would be which is just audible in a place with no noise.

IV. *Results of The Survey*

1. TYPICAL OBSERVATIONS

At most stations, the noise meter reading was observed and recorded about three or four times per minute over a period of about ten minutes. Since the noise was continually varying the pointer or needle of the meter was repeatedly swinging up and down the scale. The practice of the observers was to take a meter reading when the needle became temporarily steady; thus if a motor truck passed by, the needle would swing up to a maximum, stop, and swing back, and the reading would be made at the maximum. Similarly, when there was a lull in the noise, the minimum scale reading was observed. It was frequently possible to identify a maximum needle deflection with a particular source of noise, such as a passing motor truck, and to record the source as well as the measurement.

A series of such observations made on President Street, Brooklyn, in the afternoon, is plotted in Figure 4, with notations to indicate the causes of the noise maxima. In Figure 5 are shown similar series of observations, without notation of noise sources, for three stations differing widely in noise conditions. These plots present typical examples of the instant to instant variation of the noise meter reading which, as has already been explained, approximates to the instant to instant variation of the noise level.

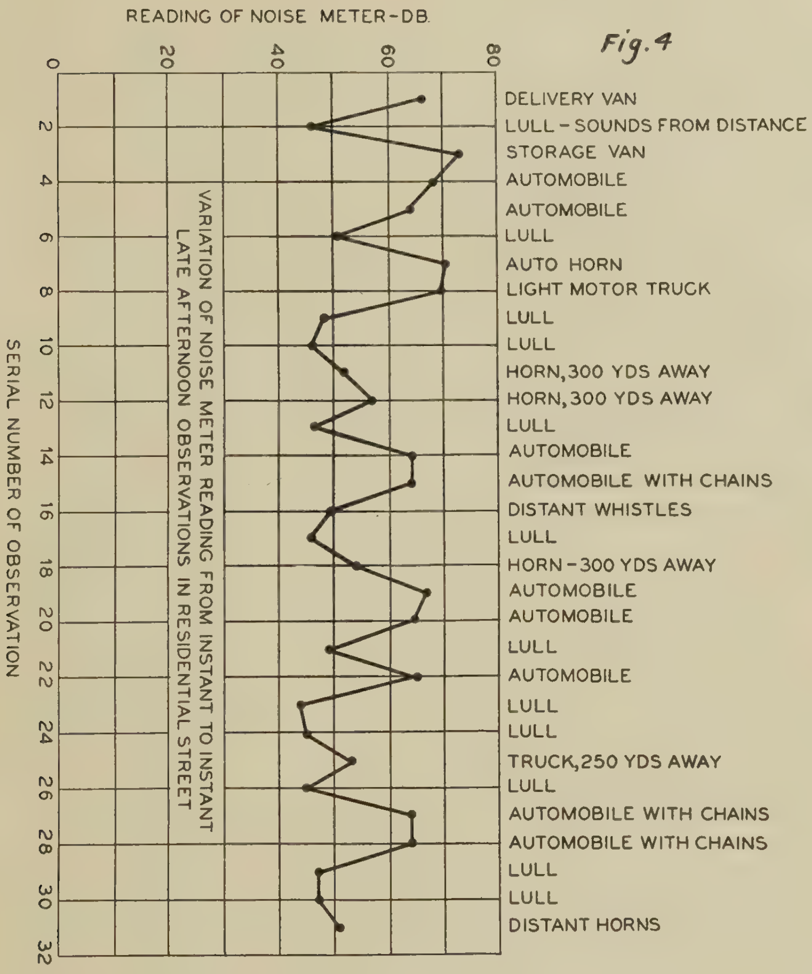


Fig. 4

2. EXTREME INSTANTANEOUS NOISE LEVELS

Examining the observations plotted in Figure 4, the minimum noise level indicated at any instant is 44 decibels and the maximum is 73 decibels.

When all the outdoor observations of the survey are thus examined, the extreme instantaneous noise levels observed are found to be as follows:

Maximum:

Level: 101 decibels.

Event: Riveter, distant 35 feet; elevated highway construction.

Location: West Street near Bethune Street.

Minimum, Day Time Tests in Entire City:

Levels: 42 and 43 decibels.

Events: Immediate surroundings generally quiet.

Locations: Corlear Avenue near 233rd Street, and Campus of New York University.

Minimum, Night Tests at Three Locations:

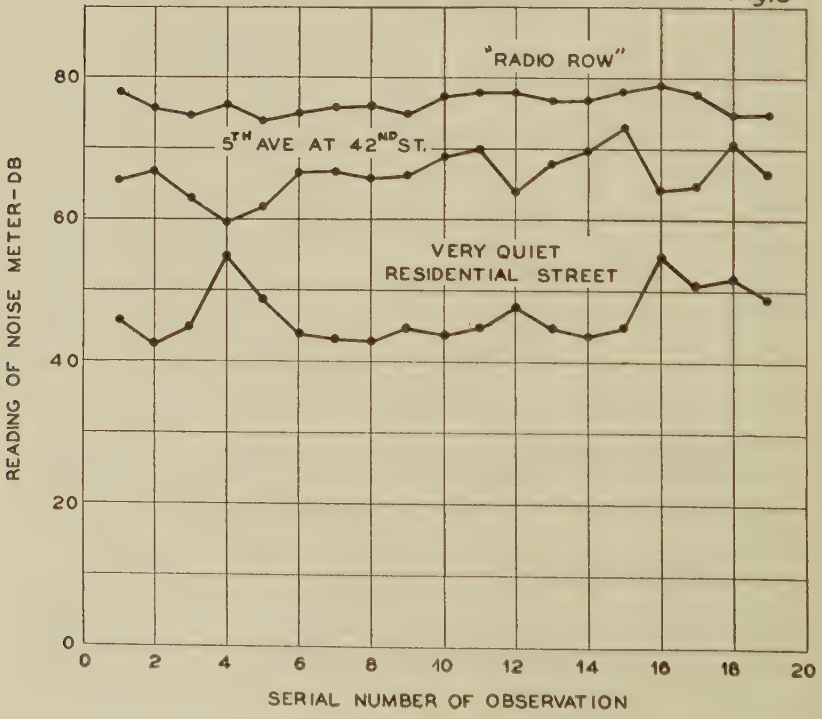
Level: 38 decibels.

Event: Immediate surroundings generally quiet.

Location: 48th Street near 8th Avenue, at *about 4:30* A. M.

VARIATION OF NOISE METER READING FROM INSTANT TO INSTANT
DAY-TIME OBSERVATIONS AT THREE DIFFERENT LOCATIONS

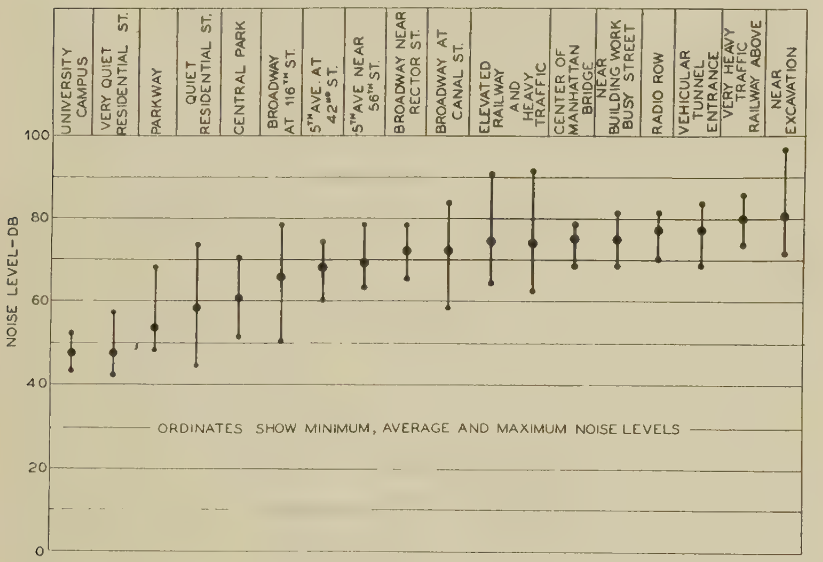
Fig. 5



3. AVERAGE NOISE LEVELS

Referring again to Figure 4, it is evident that by averaging all of the noise levels plotted, a mean or average level of about 57 decibels is found which gives a general indication of the noise experienced at the particular location. This average of the meter readings will be referred to as the average noise level for the station, which, together with the minimum and the maximum of the observed readings, indicate the prevalent range of noise levels. In Figure 6, these three levels are plotted for each of 18 different locations selected as typical of the noise levels met with in New York. More comprehensive results of the same type are given in Table 3, on pages 149, 150, 151, 152, where the minimum, average, and maximum levels are shown for 87 different outdoor locations; these constitute all of the comparable day-time outdoor tests, the remaining 10 of the 97 outdoor locations listed in Table 1 being places where the observations were of a more or less special nature.

NOISE LEVELS AT VARIOUS PLACES IN NEW YORK CITY *Fig. 6*



Since the outdoor locations are not evenly distributed geographically throughout the city, but are situated principally along rather busy and hence noisy thoroughfares, it is not possible to obtain an average noise level for the entire city by averaging the figures in Table 3. It is possible, however, to select a group of locations which have, for instance, busy street traffic, and to find from Table 3, or from Figure 6, the corresponding average noise level. Likewise, the average noise level may be found which is typical of rather quiet residential locations, or of some other group of places having similar noise conditions. These averages may be arranged to form a scale of levels, as has been done in Figure 7. A scale of noise levels in decibels is shown in the center of this chart; to the left is given, at each of several levels, an explanatory entry such as "Busy Street Traffic," derived from the present survey; to the right is given for comparison a similar column of entries embodying the results of other surveys, some of which, being obtained with different apparatus, have been translated into the noise meter scale. The identity of these other surveys may be found from Table 2, on page 148, by aid of the reference numbers in the last column of Figure 7.

The entry in Figure 7 under the caption "Minimum Noise Levels on Street: In Entire City, Day-Time, Min. Average" shows the minimum value of the average noise levels listed in Table 3. Of course, this average is greater than the least meter reading or instantaneous noise level; hence Figure 7 contains also an entry under a caption similar to that above, except ending thus "Min. Instantaneous;" against this is marked the level of 42 decibels, corresponding to the lowest level observed instantaneously in day time. A similar entry at 38 decibels gives the lowest instantaneous reading of the meter observed during the three all-night tests.

A comparison of the general range of average noise levels out-of-doors with those experienced indoors in New York demands more observations of indoor noise than were obtained in the present survey. This information is given in the chart[4] of

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[4] This chart will appear in the July 1930, issue of the Journal of the Acoustical Society of America, with a paper by Mr. Tucker on "Results of Noise Surveys: Part II Noise in Buildings."

Fig. 7 *

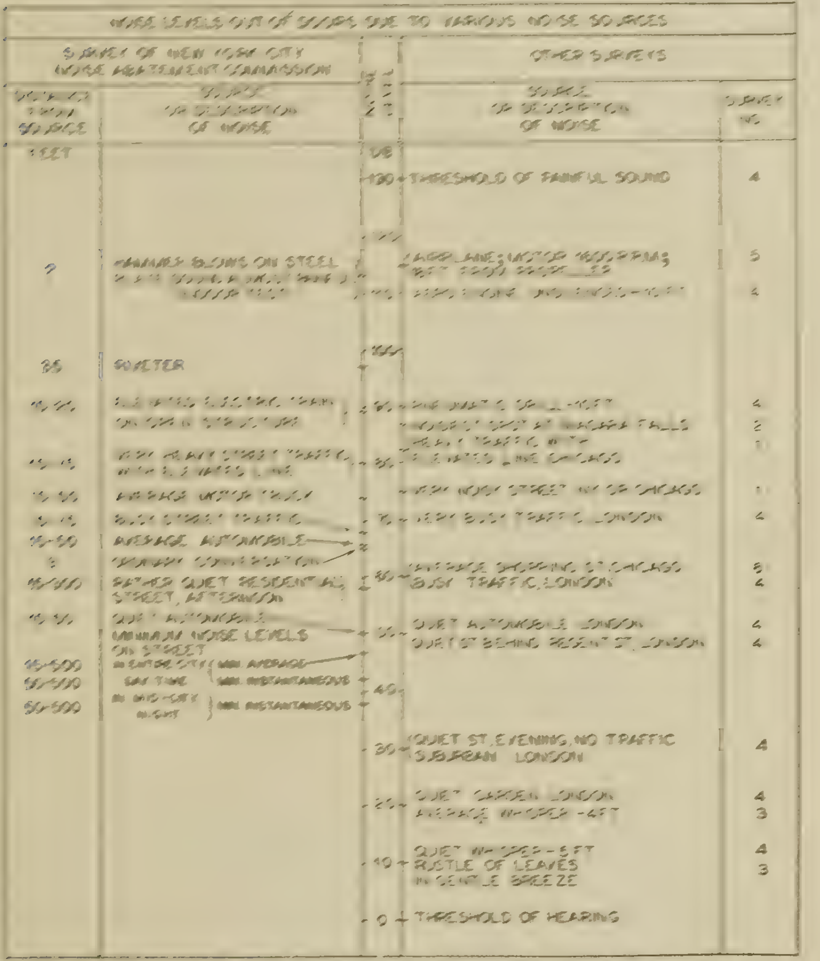
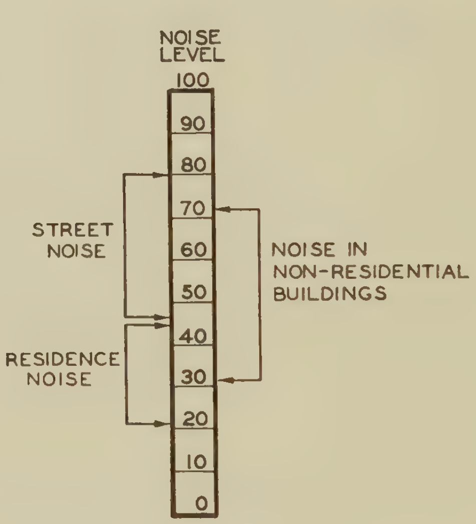


*Table showing various surveys referred to in this figure will be found on page 148.

Figure 8, which was presented before the May 1930, meeting of the Acoustical Society of America by Mr. Rexford S. Tucker, of the American Telephone and Telegraph Co., and is here reproduced by his kind permission. The chart shows the range of average noise levels found in New York in residences, and also in non-residential buildings, during the noise survey conducted jointly by the National Electric Light Association and the American Telephone and Telegraph Co., as well as the range of levels found in the streets and open spaces of the city during the present survey.

Fig. 8

RANGES OF NOISE LEVELS FOUND IN NEW YORK CITY



VALUES FOR STREET NOISE FROM NOISE ABATEMENT COMMISSION SURVEY; FOR OTHER NOISES, FROM N.E.L.A.–A.T.&T.CO. SURVEY. ALL VALUES ARE AVERAGES FOR THE LOCATIONS TESTED

4. REPETITIONS ON DIFFERENT DAYS

At five different locations, measurements were made on two or more different days, in all cases within a few hours of midday. The average noise level measured at any one of these places on one day was found to be fairly close to the average found on another day.

The following table shows these results:

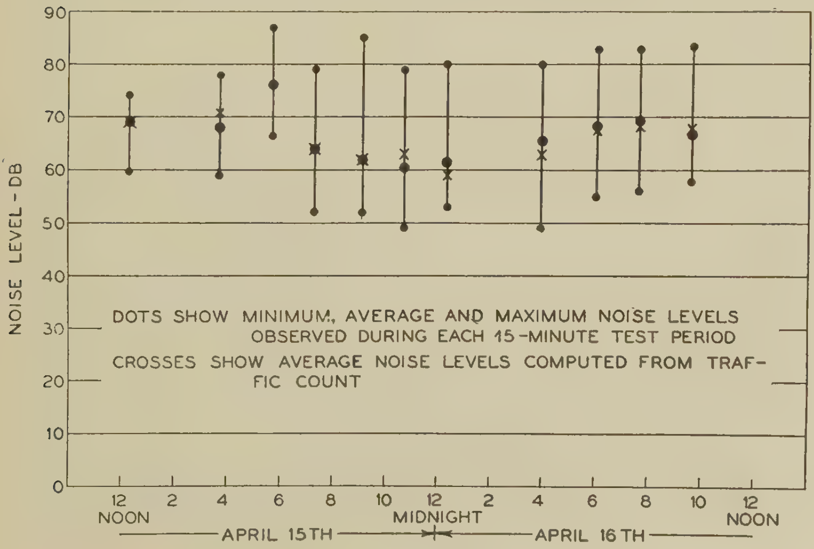
TABLE 4

Location	Average Noise Level in Decibels on Different Days			
Herald Square	73.2	73.4		
Fifth Ave. & 42nd St.	67.1	67.3	68.0	
Bowery & Canal St.	74.2	74.0	73.6	
Broadway & Canal St.	74.5	69.4	68.7	74.2
Broadway & Houston St.	72.7	70.6		

5. TWENTY-FOUR HOUR TESTS

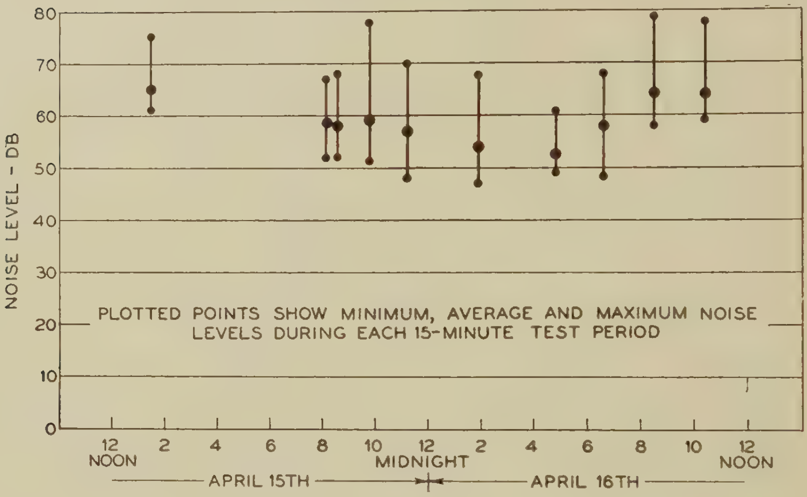
The noise level, taken during a period of about fifteen minutes, has been obtained at intervals throughout a continuous period of 24 hours at each of three locations. At one station, the corner of Canal St. and Broadway, where two of the principal highways of the city intersect, vehicular traffic is heavy throughout the 24 hours. At the second station, on Wall St. near William St., in the financial district, vehicular traffic is not very

NOISE LEVELS MEASURED DURING TWENTY-FOUR HOUR TEST
CANAL STREET AND BROADWAY, NEW YORK CITY *Fig. 9*



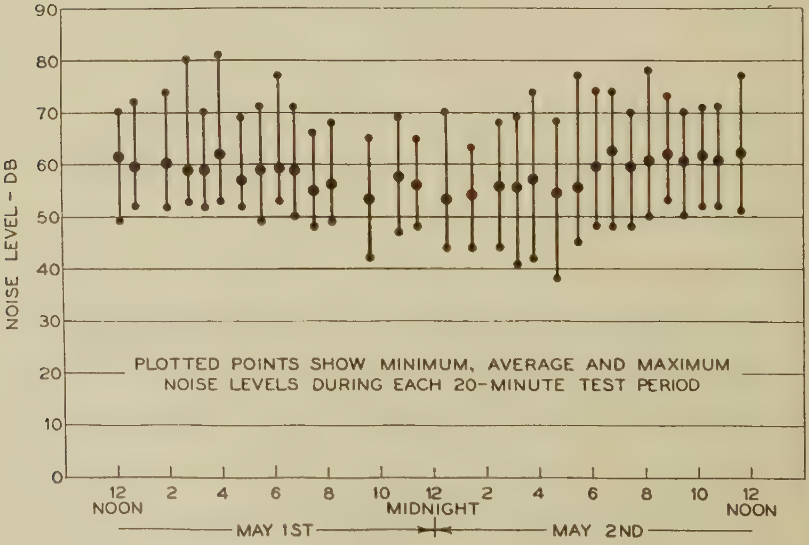
NOISE LEVELS MEASURED DURING TWENTY-FOUR HOUR TEST
WALL STREET NEAR WILLIAM STREET, NEW YORK CITY

Fig. 10



NOISE LEVELS MEASURED DURING TWENTY-FOUR HOUR TEST
48TH STREET NEAR 8TH AVENUE, NEW YORK CITY

Fig. 11



heavy by day and is quite light at night; the sounds heard here at night are produced principally by miscellaneous sources such as construction work, the underground subway, traffic several blocks away, persons walking and talking, and church bells. The third station, on 48th Street, 185 feet west of 8th Avenue, was in a residential section near the theatrical district and the rather heavy traffic of 8th Avenue. Plots of the observed noise levels are shown in Figures 9, 10, and 11. It is interesting to note that the extreme 24 hour range of the average noise level at each place covers only about 10 to 15 decibels, which is less than the range of instantaneous levels usually experienced in a period of 15 to 20 minutes.

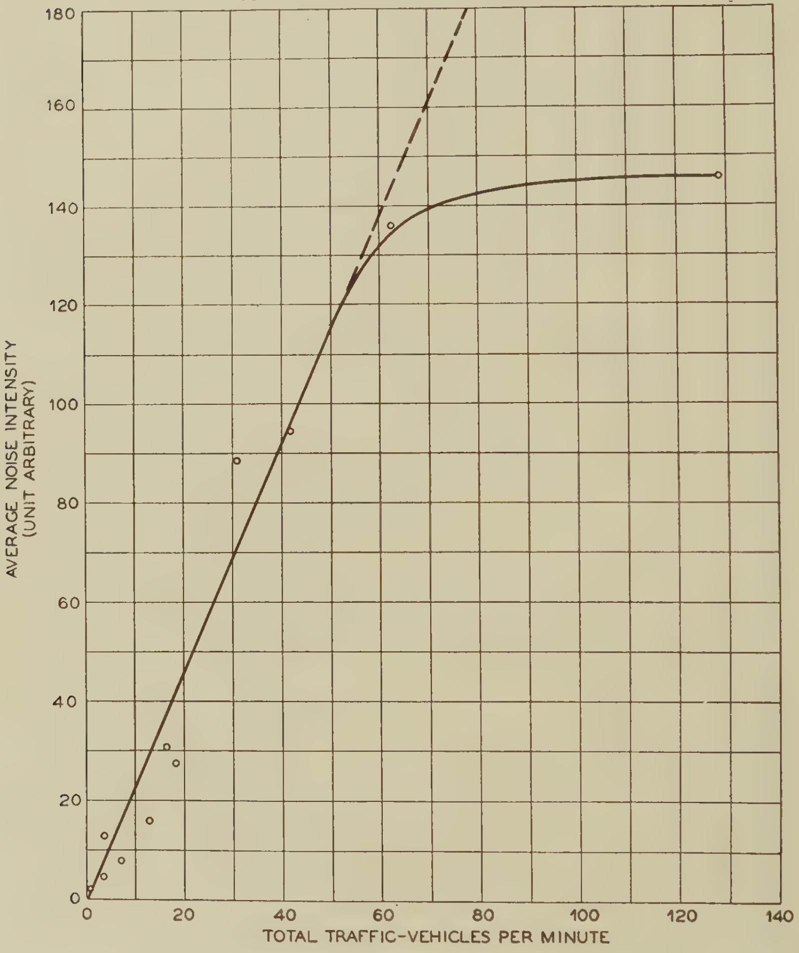
6. NOISE LEVEL vs. TRAFFIC VOLUME

As would be expected, in general those locations having the greater volumes of traffic have also the greater noise levels.

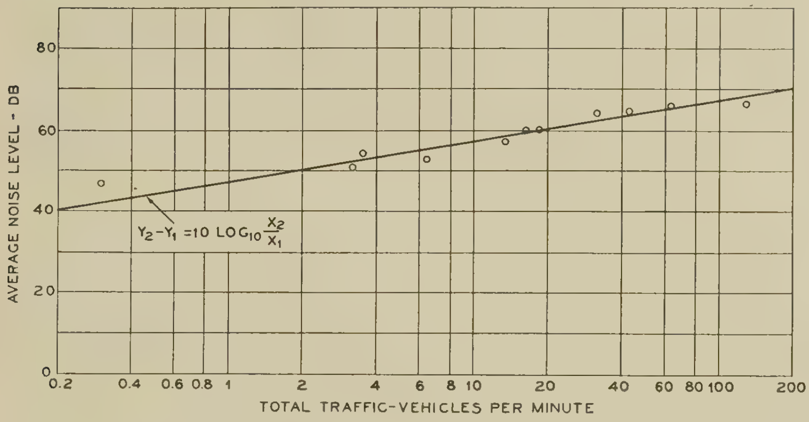
To determine the relation between the average noise level at a location and the number of vehicles passing per minute, stations were selected having approximately homogeneous traffic. Eleven stations were thus chosen for which passenger automobiles constituted 90 per cent or more of the total traffic, with no street cars or elevated trains, and the results have be plotted in two diagrams, Figures 12 and 13. In Figure 12 the horizontal scale of traffic volumes is equally spaced, so that the distance measured from the origin to a point on the horizontal axis is directly proportional to the number of vehicles per minute, which is the number of sources of acoustic power. The vertical scale in Figure 12 is a scale of acoustic power or intensity; for each station, the intensity as a multiple of threshold intensity was found for every noise meter reading, and the average of these intensities was plotted. The straight line drawn in this diagram lies reasonably close to the plotted points in the range corresponding to traffic volumes from zero to about fifty vehicles per minute; hence within this traffic range, the average noise intensity is directly proportional to the number of vehicles passing per minute, for a location where the traffic is homogeneous and where the noise is due almost entirely to the traffic. The same results are plotted differently in Figure 13. Here the

NOISE INTENSITY VS TRAFFIC VOLUME
FOR TRAFFIC OF CONSTANT COMPOSITION
PASSENGER AUTOMOBILES CONSTITUTING
90 TO 100 PER CENT OF TOTAL TRAFFIC

Fig. 12



horizontal scale of traffic volumes is logarithmic, and the vertical height of each plotted point is the average of the observed noise levels, which, being in decibels, are proportional to the logarithms of the acoustic intensities. The points plotted in Figure 13 lie close to a straight line from the slope of which the conclusion may be drawn that when the traffic volume is doubled, the average noise level is raised 3 decibels; or when the traffic volume



NOISE LEVEL VS. TRAFFIC VOLUME
FOR TRAFFIC OF CONSTANT COMPOSITION
PASSENGER AUTOMOBILES CONSTITUTING
90 TO 100 PER CENT OF TOTAL TRAFFIC

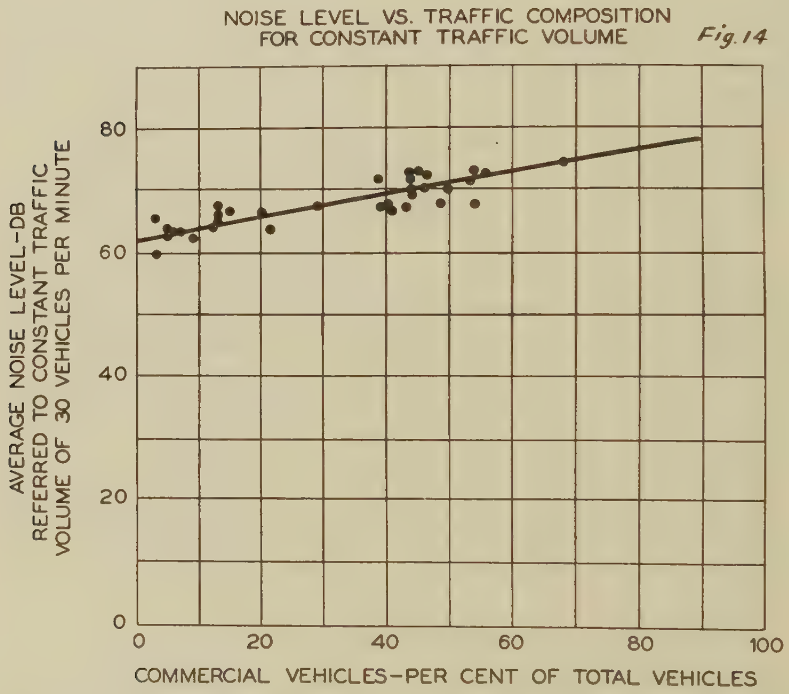
Fig. 13

is multiplied by 10, the average noise level is raised 10 decibels. For traffic volumes greater than about 50 vehicles per minute, the rate of increase of noise with traffic is less rapid; this is probably due, in part, to the greater width of street involved in heavier traffic, leading to a greater average distance between the noise sources and the microphone.

Although these results have been developed for only one type of traffic, passenger automobiles, it is probable that similar relations hold for any other type of homogeneous traffic.

7. NOISE LEVEL vs. TRAFFIC COMPOSITION

The result of changing the traffic composition, while keeping the total traffic volume constant at 30 vehicles per minute, is shown in Figure 14. Here the horizontal scale indicates the percentage which commercial vehicles constitute of the total traffic; motor trucks, horse vehicles, motor buses, and electric street cars, but not taxicabs, being included in this category. The vertical height of each plotted point shows the average noise level, either as observed, if the actual traffic volume was 30 vehicles per minute, or as computed by means of the relation illustrated in Figure 13, if some traffic volume other than 30 was observed. The plotted points of Figure 14, although somewhat scattered as would be expected from the varied character of the noise sources and general conditions, lie fairly close to the straight line shown. In a broad way, this relation may be described by the statement that an increase of 20 in the percentage of commercial vehicles results in an increase of about 3.5 decibels in the average noise level. This statement, of course applies only to those locations for which traffic noise predominates.



8. GENERAL CONCLUSIONS REGARDING NOISE vs. TRAFFIC

Based upon the two previous results, it should in general be possible to predict quantitatively, for any particular place where the noise is almost entirely due to traffic, the effect upon the average noise level which will result from a known change in the volume or the composition of the traffic; and if a detailed traffic count has been made at such a place, it should be possible from Figures 13 and 14 to estimate the average noise level, approximately, without actual noise measurements. An example of such noise estimates is shown in Figure 9, where in addition to the observed average noise levels, the computed average levels are shown as derived from the traffic count by aid of Figures 13 and 14. During one of the periods of observation, the traffic count was not made, so no computed level is plotted; for the other periods, the computed value is in error by less than 2 decibels, on the average.

9. NOISE DUE TO SPECIFIC SOURCES

Two methods were followed in obtaining a measure of the noise due to a specific type of source. In certain instances, such as the observations of a steamship whistle and of a nearby riveter, it was possible to place the microphone at an especially chosen location where the particular noise was definitely predominant, and where the distance from source to microphone could be measured with considerable accuracy. In other instances, such as observations of the noise due to motor vehicles, the microphone was placed near the stream of traffic and the observers awaited a favorable chance to read the noise meter when the predominant noise was judged by the ear to be due, beyond question, to one particular source or another; in such cases, the noise level and the distance of the source were varying from instant to instant, and the practice was to record the maximum deflection of the meter needle and to estimate the distance within reasonable limits. The observations shown in Figure 4 illustrate these chance observations. In a large group of such measurements of the noise due to some one type of source, such as a motor truck, there is quite a wide range of results, since individual trucks differ in noisiness, as does the same truck under different conditions of operation, while the distance from truck to microphone and the local surroundings also vary. It is possible, however, from the average of a large number of observations of motor trucks, and from the minimum and maximum values, to define a range of noise levels which is fairly characteristic, and which may be compared with similar figures for other types of noise sources. In the chart of Figure 7, the average levels are shown which were found in this way for motor trucks and for passenger automobiles; in Table 5, the minimum, average and maximum values are given for a number of the most common sources of noise in New York. The distances from source to microphone given in the table are those actually experienced; if the noise level at some other distance is desired, it may be computed approximately on the assump-

Table 5

NOISE DUE TO SPECIFIC SOURCES

SOURCE OR DESCRIPTION OF NOISE	NOISE LEVEL MINIMUM DB.	NOISE LEVEL AVERAGE DB.	NOISE LEVEL MAXIMUM DB.	DISTANCE: SOURCE TO MICROPHONE	NUMBER OF OBSERVATIONS
HAMMERING ON STEEL PLATE, 4 BLOWS PER SECOND		113		2 FT	1
RIVETER AS HEARD NEARBY	94	97	101	35	16
AS HEARD ORDINARILY ON STREET		79.5		200	3 *
BLAST OF EXPLOSIVES OPEN CUT DIGGING		96		50	1
SUBWAY STATION UNDERGROUND: NOISE ON PLATFORM: LOCAL STATION: EXPRESS TRAIN PASSING	88	94	97	15-25	5
LOCAL STATION: LOCAL TRAIN	85	88.5	91	6-30	3
5 TURNSTILES: RUSH HOUR	78	83	91	3-7	19
STEAMSHIP WHISTLE WHISTLE RATHER LOUD TESTS NEARBY	92	93	94	115	4
TESTS IN 10th FLOOR OFFICE: WINDOWS OPEN	59	61	65	1450	4
AS HEARD ORDINARILY ON STREET	47	56	68	2500	14
AUTOMOBILE HORN 34 TYPES, DIRECTED TOWARD MICROPHONE	72	91	102	23	34
AS HEARD ORDINARILY ON STREET	57	71.5	85	25-100	80 *
ELEVATED ELECTRIC TRAIN, ON OPEN STRUCTURE AS HEARD NEARBY	85	89	91	15-20	7
AS HEARD ORDINARILY ON STREET	70	81.5	91	15-75	54 *
AS HEARD AT 750 FT.	51	57.5	63	750	27
CONSTRUCTION AND EXCAVATION. PILE DRIVER, STEAM OPERATED	84.5	87	90	20-80	18
TWO STEAM SHOVELS, WITH ROCK DRILL	81	82.5	86	50	10
HAMMERING, BUILDING		76.5		100	3
IN BRONX ZOO HOUSE LION ROARING	87	87	87	18	3
SIBERIAN TIGER ROARING	70	79.5	87	7	15
BENGAL TIGER SNARLING	67	75.5	80	15	11
FIRE APPARATUS SIREN AND BELL		83		100	1
BELL. FIRE CHIEF'S CAR		81		50	1
POLICE WHISTLE AS HEARD NEARBY	80	82	83	15	4
AS HEARD ORDINARILY ON STREET	64	74	83	15-75	53 *
AS HEARD AT 185 FT	55.5	57.5	62	185	6
RADIO LOUD SPEAKER ON STREET	73	79	81	30	10
MOTOR TRUCK EXHAUST NOT MUFFLED	70	77.5	87	15-50	15
CHANGING GEARS	68	74	83	15-50	7
AS HEARD ORDINARILY ON STREET (NOT INCLUDING HORN)	55.5	73.5	87	15-50	203 *
SUBWAY NOISE ON STREET THROUGH GRATING. AS HEARD 5½ FT ABOVE GRATING	74	77	79	5½	6
AS HEARD ORDINARILY ON STREET	60	69	79	5½-50	17 *
ELECTRIC STREET CAR MOVING FAST	73.5	76.5	77.5	10-15	10
OVER TRACK CROSSING	68	74	81	40	26
AS HEARD ORDINARILY ON STREET	63	72.5	83	15-50	129 *
MOVING SLOWLY	68.5	69.5	70.5	10-15	6
SNOW SCRAPING AND SHOVELLING		75		15	1
HORSE-DRAWN VEHICLE AS HEARD ORDINARILY ON STREET	63	74.5	83	15-50	23 *
ON ASPHALT STREET	47	61	72	15-50	100
MOTOR BUS CHANGING GEARS	68	71	75	15-50	10
AUTOMOBILE SQUEAKING BRAKES	62	71	76	15-50	10
CHANGING GEARS	60	70.5	83	15-50	10
EXHAUST	64	70	74	15-50	4
AS HEARD ORDINARILY ON STREET (NOT INCLUDING HORN)	50	65.5	83	15-50	162 *
THUNDER	60	64	70	1-3 MI	9
DOG BARKING, ON STREET	49	63	76	20 FT	12
THREE AIRPLANES, IN FLIGHT OVER CITY		62		3000	2
HORSE TROTTING ON ASPHALT STREET	52	61	65	15	8
SAWING WOOD		61		30	1
CHURCH BELLS	52	57.5	61	1200	5

tion that the acoustic intensity varies inversely as the square of the distance from the source. Expressed in decibels, the equivalent statement is that if the noise level is given in the table for a certain distance, the level at twice that distance will be less by 6 decibels; at ten times the distance, by 20 decibels.

The last column of Table 5 shows the number of observations made upon each type of source. For a certain group of sources, these numbers—each marked with an asterisk—indicate how frequently, during a large part of the survey, the noise from each type of source was recorded as predominant over all other noises.

In addition to the general observations throughout the city which largely make up Table 5, a number of other measurements upon passenger automobiles, motor trucks, and horse-drawn vehicles were made during a 24 hour test at a particular location, on 48th Street about 185 feet west of 8th Avenue. The average and maximum noise levels for motor vehicles, and the whole range of levels for horse-drawn vehicles, were distinctly lower here than the corresponding levels measured in general throughout the city. The explanation in the case of horse-drawn vehicles seemed so evidently to be the asphalt street surface of 48th Street that an entry of the observations was included in Table 5. For motor vehicles, a large percentage of which when passing the microphone were coasting in their approach to 8th Avenue, it was thought best to omit the measurements from Table 5 as not typical of these particular sources of noise under general conditions. These observations are mentioned, however, as indicative of the variety which may occur in noise measurements under different conditions.

10. SPECIAL RESULTS FOR ELEVATED TRAINS AND STREET CARS

In order to get some idea of the noise reduction which might follow the removal of an elevated railway from a street, the average noise level was computed, for several Manhattan stations near elevated lines, for two conditions: first, using all observations; secondly, using all observations except those made when elevated trains were passing. It appears that if no trains run, the average noise level is reduced 3 decibels, and the maximum noise level 7 decibels. These figures are applicable to a street with rather busy traffic. For a street which is very quiet except for the noise due to an elevated line, the reduction due to removal of the line would probably be appreciably greater.

Of course, no account is taken here of the possible effect of removing the elevated structure.

Another set of data bearing on the noise due to elevated trains was obtained at stations near the Flushing elevated line. Comparing the street-level noise due to trains passing over an open iron-work structure and over a structure of solid masonry, the open structure seems to result in a noise level that is about 10 decibels greater. There is some uncertainty regarding this figure, since the speed of the trains during the test appeared to the observers to be lower on the concrete than on the open structure.

The possible noise reduction which might be effected by removing electric street cars has been estimated by the method applied to elevated trains—that is, by considering the noise levels at various locations with and without the observations made when street cars were passing. The indication is that the presence of the street cars raises the average noise level by about 1 decibel and the maximum by about 3 decibels; these figures vary greatly with the street traffic, and might be appreciably greater for streets having very light automotive traffic.

11. STREET NOISE IN ROOMS

The noise level inside a room due to sources of noise upon an adjacent street depends upon the position of the room with respect to the street, upon whether or not the windows are open, and upon the size, shape, and absorptive material which characterize the room. In general, it may be said that for a third story room, looking out directly onto a street, the noise level in the room, due to the street sounds, is ten to twenty decibels below the level on the street if the windows are open, and fifteen to thirty if the windows are closed.

12. NOISE IN AND AROUND HOSPITALS AND SCHOOLS

At Flower Hospital, the noise level in third story rooms, due principally to out-of-door noise sources, was found to be about 52 decibels when windows were open.

This level is about that of an average New York City business room.

The noise levels in the streets adjacent to the buildings of the Medical Center at 168th Street, Manhattan, are in general less by 5 to 10 decibels than those in the streets near Flower Hospital.

The average street noise level near Public School No. 7, 3205 Kingsbridge Avenue at 232nd Street, is about 48 to 53 decibels; for P. S. No. 33, 2424 Jerome Avenue near Fordham Road, the corresponding level is 58 to 68 decibels. At P. S. No. 7, no trouble is experienced from outside noise.

13. NOISE DUE TO STEAMSHIP WHISTLE

An observation was made of the noise produced by a steamship whistle which was blown at the time of departure of the vessel from the dock in Hudson River. With the microphone located on the pier at a distance of about 115 feet from the whistle, a level of 94 decibels maximum, 93 decibels average, was observed. As the vessel pulled out, this level fell off approximately in accordance with the open air law of decrease in intensity, i. e., the intensity varied inversely as the square of the distance.

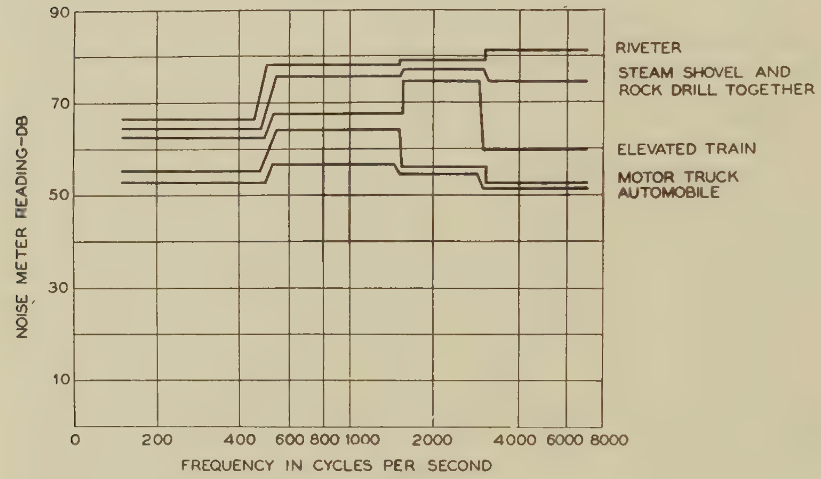
A simultaneous observation was made of the noise level in a tenth story room with windows open looking directly out towards the steamship, 1450 feet distant. The noise level in the room was from 58 to 64 decibels, varying apparently with the wind conditions. Observers in the room, familiar with the customary level attained by steamship whistles, regarded this level as distinctly lower than that frequently resulting from similar whistle blasts. It may therefore be concluded that the noise level in an ordinary room due to a loud steamship whistle a quarter of a mile away, may reach the level of 70 or 75 decibels. This is consistent with the well-known fact that such sounds frequently interfere seriously with conversation.

14. PHYSICAL ANALYSIS

A physical analysis of noise into four frequency bands was accomplished by means of the four band-pass filters already mentioned.[5] The apparatus in tandem with the filters was not

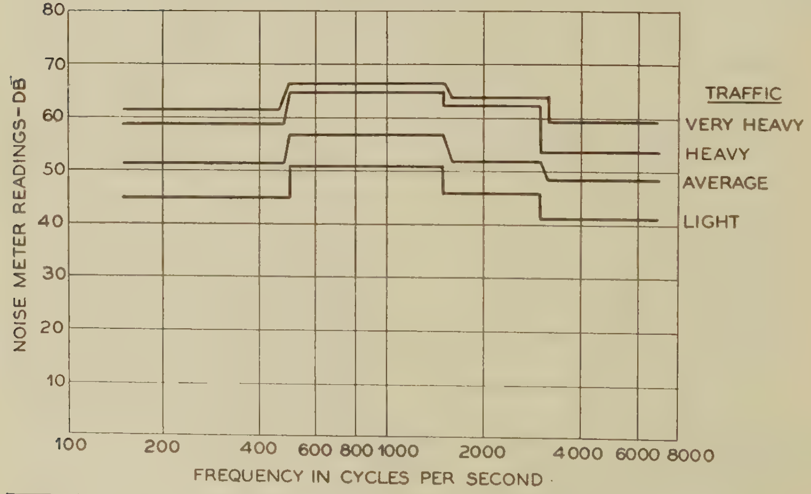
PHYSICAL ANALYSES OF VARIOUS NOISES

Fig. 15



PHYSICAL ANALYSES OF TYPICAL NEW YORK STREET NOISE

Fig. 16



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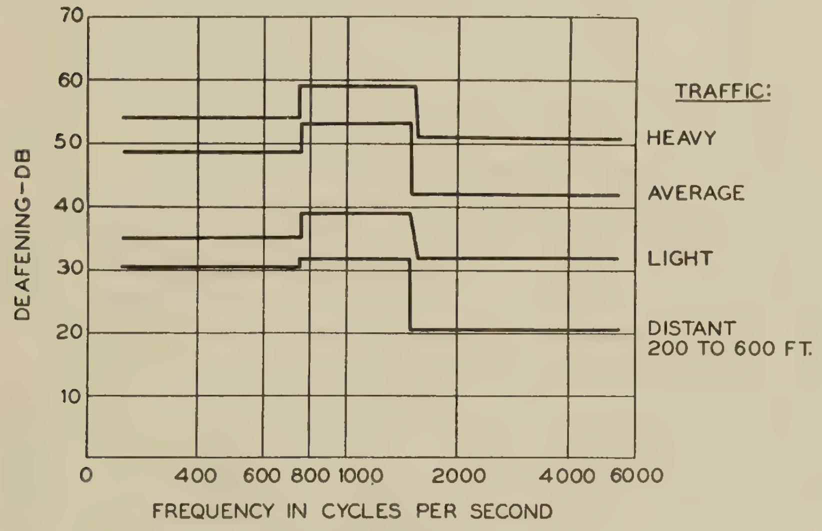
[5] See page 121.

distortionless, the frequency weighting network of Figure 2 being permanently included. Consequently, when the meter readings corresponding to the various filters are compared, it must be remembered that the comparison is not between the total amounts of power conveyed by components in the different bands, for the network discriminates against the very low and the very high frequencies.

Typical results of the filter analysis are given in Figures 15 and 16. Although the shape of the plots in Figure 15 is by no means uniform, indicating considerable differences between the waves due to various specific sources, the result of summing up a large number of sources is shown by Figure 16 to be an aggregate street noise which, however it may vary in level, usually retains substantially the same relative distribution of intensity.

AUDIOGRAMS OF OUTDOOR NOISE
IN NEW YORK

Fig. 17



15. DEAFENING DUE TO NOISE

The deafening effect of the noises encountered was measured in the three frequency bands: 250-750 cycles, 750-1500 cycles, and 1500-5600 cycles per second. In a broad way, the audiograms of street noise are of the same general type, showing almost always a deafening in the middle band greater by 3 to 10 decibels than in either of the other bands: Examples of the audiograms of the noise due to street traffic are given in Figure 17.

Generally speaking, the middle band deafening is about 14.5 decibels less than the noise level as measured by the noise meter. It is thus usually possible, for the noises found, to derive the observations made with one instrument from those made with the other, to within about ±5 db.

The following table shows the average or normal deafening in each band for six of the locations listed in Table 1:

TABLE 6

	Average Deafening in Decibels		
Location	Cycles 250-750	Cycles 750-1500	Cycles 1500-5600
N. Y. University Campus	31	32	21
Mosholu Parkway	35	39	32
Central Park, southern end of Mall	45	48	36
Fifth Ave. & 42nd St.	53	54	47
Manhattan Bridge, near center	62	63	49
Bowery & Canal St. under elevated tracks	58	67	54

16. INTENSITY OF ACOUSTICAL TRAFFIC SIGNAL

On the basis of the street noise audiograms, a level in each frequency band may be assigned which a sound must attain in order to be distinctly audible. The sound levels are indicated in Table 7:

TABLE 7

Street Noise	Sound Level in Decibels Required For Distinct Audibility: Frequency Band		
	Low	Middle	High
Average	60	60	50-55
Maximum	75	80	70-75

The figures refer to decibels above threshold. The values for maxima apply to normal conditions; exceptional noise levels, such as that due to a blast of explosives, may involve still greater levels of sound.

Comparing with these figures the measured level of sound from a policeman's whistle in Table 5, it is evident that no great reduction in intensity is permissible, if the whistle is to be audible in the loudest normal traffic at a distance of 50 to 100 feet.

Tests of automobile horns indicate that certain of the loudest produce unnecessarily great levels of sound.

17. ANNOYANCE EFFECTS

A test was made to determine whether or not any evident correlation exists between the overall noise level of each specific source and the frequency of complaints against the source, as compiled by Mr. Dennis of the Noise Abatement Commission. It can be definitely stated that the level of the noise is not the sole factor which determines its annoyance as measured by the number of complaints. In a broad way, it does seem that a factor combining the noise level and the frequency of occurrence is definitely correlated with the annoyance. However, the degree of annoyance seems to depend at least to an equally great extent upon other factors—possibly the component frequencies and the general character, whether steady or intermittent—and whether or not the noise is commonly regarded as quite unnecessary, such as the squeaking of brakes of automobiles, or as relatively necessary, such as police whistles. In this connection it may be remarked that some idea of the relative frequency of occurrence of certain common noise sources is afforded by those entries which are marked with an asterisk in the last column of Table 5.[6]

VI. *Conclusion*

In so far as the results of previous surveys are available, they seem to be generally in harmony with the results of the present survey.

Those who have taken part in planning and carrying out the field work of the survey described in this report are: Messrs. J. S. Parkinson, C. W. Meyer, and J. Lenhardt, of the Johns-Manville Corporation; Messrs. S. M. MacGonigle and C. Scheppler of the Department of Health of the City of New York; Messrs. H. Fletcher, J. C. Steinberg, T. G. Castner, H. Kahl, L. Y. Lacy, A. W. Treptow, F. M. Carlisle, A. Meyer, K. P. Seacord, and R. H. Galt, of the Bell Telephone Laboratories.

ROGERS H. GALT.

TABLE 2

Explanation of Survey Reference Numbers of Figure 7

Survey Reference Number	Instrument	Method	Reference
1	Buzzer Audiometer	Balance	E. E. Free, "The Forum," Feb. 1926; March 1928
2	" "	Deafening	K. P. Royce, special tests
3	" "	Balance	W. Waterfall, "Eng. News Rec." Jan. 10, 1929
4	Tuning Fork 640 cycles	Balance or Deafening	A. H. Davis, "Nature," Jan. 10, 1930
5	Warbling "	Deafening	W. A. MacNair, special tests
6	Buzzer "	Balance	D. A. Laird, "Sci. Amer.," Dec. 1928
7	Acoustimeter	Physical	R. F. Norris, Results presented before Chicago Board of Health

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[6] See page 140.

TABLE 3*

Location	Noise Level in Decibels Minimum	Average	Maximum
Bronx: N. Y. University Campus in front of Library	43	46.5	52
Corlear Ave., entrance to P. S. No. 7	42	47	57
Brooklyn: Clarkson Ave. & E. 37th St.	43	51	61
Flower Hospital, court near dispensary	48	52.5	58
Bronx: Mosholu Parkway near Bainbridge Avenue	48	52	68
Fort Washington Ave., between 167th and 168th Streets	48	54	65
Vanderbilt Clinic, entrance court; oft Broadway at 167th Street	49	57	66
Central Park, West Drive near 102nd St. entrance	46	57	64
Brooklyn: President St. between New York & Brooklyn Aves.	44	57.5	73
Bronx: Walton Ave., south of Fordham Road near P. S. No. 33	51	58	69
North side of Union Square, 100 ft. east of Broadway	55	60	68
Central Park, southern end of the Mall	51	60	70
Ambulance court of Flower Hospital on York Avenue	50	60	73
48th Street near 8th Avenue	49	60	81
Foot of West St. at Battery Place, 100 yds. N. W. of Aquarium	57	60.5	67
Foley Square, Corner of Pearl St. and City Hall Place	57	61.5	69
Brooklyn: Eastern Parkway near Institute of Arts	52	61.5	74
63rd St., near children's ward of Flower Hospital	54	61.5	72

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*Unless otherwise indicated, the locations refer to the Borough of Manhattan. All measurements contained in this table were made between the hours of 9:30 A.M. and 6:00 P.M.

TABLE 3* (Continued)

Location	Noise Level in Decibels Minimum	Average	Maximum
Broadway at 167th St., Vanderbilt Clinic entrance	52	62.5	73
5th Ave., between 82nd and 83rd Sts., opposite Metropolitan Museum of Art	48	63	73
Park Ave. and 94th Street	58	63.5	73
Broadway and 28th Street	55	64	75
5th Avenue and 95th Street	52	64	73
Broadway at Murray St., opposite City Hall	59	64.5	69
Bowling Green, 100 ft. N. of Custom House	60	64.5	73
Wall St. near William St.	59	64.5	77.5
Broadway and 116th St.	50	64.5	78
Brooklyn: Grand St. and Union Ave.	57	65	71
Columbus Circle, south side of Central Monument	61	65	72
York Ave. and 64th St., at north pavilion of Flower Hospital	53	65.5	78
Bethune and Washington Streets	55	65.5	76
7th Ave. between 46th and 47th Sts.	60	66	71
5th Ave and 72nd Street	50	66	83
Park Ave. and 80th St.	59	66	74
Broadway and 81st St.	54	66	77
Ramp south of Grand Central Terminal, 42nd St. and 4th Ave.	61	66	72
Brooklyn end of Manhattan Bridge	62	66.5	72
Broadway and 73rd St.	57	66.5	76
Queen's Boulevard, near 50th St.	55	66.5	78
Park Ave. and 59th St.	59	66.5	74
110th St. and Central Park West S. E. corner	55	67	79
Brooklyn: Borough Hall, Court and Fulton Sts.	59	67	74

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*Unless otherwise indicated, the locations refer to the Borough of Manhattan. All measurements contained in this table were made between the hours of 9:30 A.M. and 6:00 P.M.

TABLE 3* (Continued)

Location	Noise Level in Decibels Minimum	Average	Maximum
42nd St. and Vanderbilt Ave.	63	67.5	73
5th Ave. & 42nd St., S. W. Corner at Public Library	60	67.5	74
Queen's Boulevard between 37th & 38th Sts.	57	67.5	80
Park Ave. and 104th St.	56	67.5	83
Broadway at Lincoln Square	55	68	75
Brooklyn: Manhattan Ave. S. of Java St.	53	68	78.5
Herald Square, 35th St. between Broadway and 6th Ave.	61	68	82
Broadway and 42nd St.	60	68.5	77
Queen's Boulevard between 36th and 37th Sts.	54	69	79
West and Bethune Sts.	64	69	79
Broadway and 39th St.	61	69	76
5th Ave. between 55th and 56th Sts.	63	69	78
Canal St. at Broadway	58	69	87
West and Canal Sts.	64	69.5	76
Bronx: Jerome Ave. S. of Fordham Road at P. S. No. 33	58	69.5	94
Broadway between Worth St. and Catherine Lane	63	70	80
Broadway between Cedar and Liberty Sts.	66	70.5	78
Broadway and 14th St., S. E. corner	62	70.5	78
Broadway and 53rd St.	62	70.5	85
34th St. and 10th Ave.	63	70.5	77
Broadway and 23rd St., S. E. corner	60	70	84
14th St. and 7th Ave.	65	71	78
Broadway between Rector St. & Exchange Place	65	71.5	78
Broadway at Canal St.	63	72	86
1st Ave. and 34th St.	58	72	81

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*Unless otherwise indicated, the locations refer to the Borough of Manhattan. All measurements contained in this table were made between the hours of 9:30 A.M. and 6:00 P.M.

TABLE 3* (Continued)

Location	Noise Level in Decibels Minimum	Average	Maximum
Brooklyn: Intersection of Fulton & Nevins Sts. & Flatbush Ave.	66	72.5	81
West St. at 13th St.	65	72.5	86
Broadway and Astor Place	61	72.5	84
42nd St. and 9th Ave.	66	73	81
7th Ave. and 18th St.	60	73	86
Broadway and Houston St.	60	73.5	83
Herald Square, southern point, N. W. corner of 34th St. & 6th Ave.	64	73.5	90
Bowery and Canal St., S. E. corner	65	74	81
Cortland St., N. side between Greenwich and Washington Sts.	70	74	81
Manhattan Bridge near center	68	74	78
Park Ave. and 71st St.	68	74.5	81
West Broadway and Canal St.	64	75	85
Bronx: Intersection of Third Ave., 149th St. and Melrose Ave.	62	75	91
1st Ave. and 14th St.	62	75.5	87
Holland Tunnel entrance, Manhattan	68	76	83
Cortland St., S. side between Washington & Greenwich Sts.	74	77	81
Bowery and Canal St., under elevated tracks	73	79	85
West St. at Bank St.	67	79.5	90.5
Bronx: Grand Concourse between 196th St. & Kingsbridge Road	71	80	96
West St., between Bank & Bethune Sts.	67	81	88.5

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*Unless otherwise indicated, the locations refer to the Borough of Manhattan. All measurements contained in this table were made between the hours of 9:30 A.M. and 6:00 P.M.

Noise in Buildings

NOISE experienced indoors is in one sense more important than that experienced outdoors, for, with the growth of our industrial civilization, increasing numbers of people are spending most of their waking hours indoors. They are thus exposed to indoor noise for a large part of the time, including the hours of work when noise has its opportunity to impair their working efficiency.

Certain typical values for noise in various locations in buildings have been published, and will be summarized below. Our knowledge of indoor noise levels is far from complete, however. Further information has been obtained in a survey of room noise in New York City and the surrounding area which was made in 1929 by the National Electric Light Association and the American Telephone and Telegraph Company in the course of the work of their joint subcommittee on Development and Research. Some results of the New York City measurements are given herein. About 70 test locations are included. It will be realized that this is only a small sample of the total number of places where indoor noise is experienced in New York City alone. The conclusions given must, therefore, be regarded only as suggestive rather than as holding true in any general sense.

Joint Survey

The methods of measurement employed in this survey were substantially the same as those used in the survey of outdoor noise in New York City described in the report of that survey. They comprise a three-band audiometer method and a meter method, the noise meter having a thermocouple output and being classed as relatively slow-acting. The results obtained by the meter method are given in the same terms as those obtained with the meter used in the outdoor survey, namely, in terms of noise level. The necessary calibration factor was obtained through simultaneous measurements of several noises by the two noise meters[1].

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[1] The noise level was obtained for this meter by adding 25 db to the scale reading on the particular noise meter used.

The results from the two surveys have been made as directly comparable as possible. Comparisons between them, especially in the case of the audiometer measurements, are, however, subject to minor errors due to differences between the observers, apparatus, and technique of measurement employed in the two series of tests.

Since the primary object of this survey was to gather information for telephone studies, the noise was measured in each case near a telephone instrument; and, in any case where a selection of conditions was necessary, it was endeavored to simulate conditions which would obtain when a telephone call was placed. The noise was taken to include any room sounds which would tend to interfere with telephone conversation.

The measurements reported here were made in the months of January to April.

The results are naturally separated into those for residential and non-residential locations; there is a distinct difference in the general noise level and in the sources of noise in these two kinds of places. About half of the measurements were made in each type of location.

Residence Noise

The residential locations visited in New York City were chiefly apartments and generally situated on side streets. The hours of measurement were fairly evenly distributed among morning, afternoon, and evening.

The average of the meter measurements for these residential locations was a noise level of 31 db. The minimum noise level encountered was 22 db.[2] This was found in two places. One was a private residence on a side street in Brooklyn, the noise being due to miscellaneous sounds in the house, to the talk of children on the sidewalk, and to the rustle of the wind, the windows being closed. The other was a hallway on the ground floor of an apartment house on a side street near Central Park, the noise being composed of sounds leaking out from the apartments, street noise contributing a negligible amount. The highest noise level encountered was 45db; this was found in a room in the rear of an apartment house in Brooklyn, and was due to a pneumatic hammer operating in a nearby street.

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[2] Any value given for a particular location is an average for that place.

This maximum value is just below the lowest average daytime value for any station where measurements were made in the New York Noise Abatement Commission survey. Though it would, of course, be possible to find higher levels of noise than this in New York homes and lower levels outdoors within the city limits, it can be safely said that the general level of noise on New York streets is much higher than that experienced in New York residences.

The average masking for the residence locations was 16 db on the low-frequency band, 17 db on the middle band, and 12 db on the high band.[3] The masking results show no significant difference in frequency make-up between these residence noises and the street noises measured in the Noise Abatement Commission survey. The main differences seem to be in the levels and the sources of the noise.

As to the sources of noise, in 20 cases the chief contributing source was indoors (for example, conversation, movement, or work going on in the apartment); in 11 cases, it was outdoors (traffic or building construction). Of the highest eight noises, half were due chiefly to indoor sources and half to outdoor sources. Radio sets and sounds coming from adjacent apartments contributed very little of the noise measured in the class of places which were visited.

Noise in Non-Residential Locations

Of the measurements in non-residential locations about one-half were made in offices in downtown New York, about one-fifth were made in factories and workshops, and the rest were made in retail stores and in public buildings such as clubs. Most of the measurements were made in the daytime.

The average of the meter measurements for the non-residential locations was a noise level of 51 db. The minimum noise level encountered was 32 db and was found in a telephone booth in a retail store; only a very few measurements were made in telephone booths. The maximum level, 72 db, was found in a large machine shop; this was due to metal-working machinery and to a man hammering on a sheet of galvanized iron, no major source of noise being as near as 10 feet to the observer.

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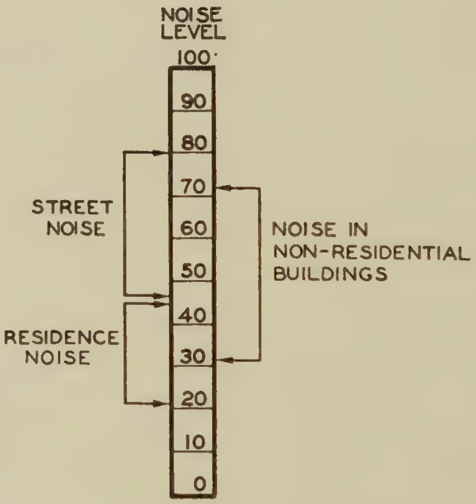
[3] These figures have been adjusted to the basis employed for the outdoor survey, by making corrections for the difference between the values for threshold of audibility employed in the two cases and for the slight distortion of noise in passing through the slots of the receiver cap. If expressed on the basis employed for the results of the complete indoor survey, published elsewhere, they would be 15, 21 and 12 db, respectively.

It will be noted that the average noise level for these locations was 20 db higher than the average residence level. The range of levels is greater for these locations, reaching well up into the range found on New York streets. A comparison of the ranges of levels found in the two surveys is given on Figure 1.

Fig. 1

RANGES OF NOISE LEVELS FOUND IN NEW YORK CITY



VALUES FOR STREET NOISE FROM NOISE ABATEMENT COMMISSION SURVEY; FOR OTHER NOISES, FROM N.E.L.A.-A.T.&T. CO. SURVEY. ALL VALUES ARE AVERAGES FOR THE LOCATIONS TESTED.

The average masking for the non-residential locations was 37 db on the low-frequency band, 41 db on the middle band, and 31 db on the high band.[4]

As in the case of residential locations, the chief sources of noise were located indoors, the predominating source being indoors in 27 cases and outdoors in 12 cases. Practically all of the highest noises were caused mainly by machinery, using this term to include machines in factories, hand-operated tools, and machines used in office work. The noise coming from outdoors was largely due to street traffic.

Some data are available on the differences between noise levels in different locations in a single building. Twelve measurements were made in a single office building in downtown New York. In seven of these cases noise from indoor sources predominated, the noise levels ranging between about 35 and 60 db—over half the total range for all non-residential locations tested. In the five cases where outdoor noise sources were most prominent, the noise levels ranged between about 40 and 50 db. It will be noted that for this building neither the highest noise levels in the rooms nor the range of noises could be predicted from a study of the noise due to outdoor sources alone. The difference in the noise levels observed was in many cases due to differences in the uses to which these rooms were put, and in some cases was affected by the fact that the windows of rooms exposed to high street noise were opened less than those in other rooms.

Relation Between Noise Level and Masking

The difference between noise level and middle-band masking, obtained as an average of the results for residential and non-residential locations, was found to be 12 db. The corresponding figure obtained from the complete room noise survey is 14.5 db. This may be compared with the figure 14.5 db given in the previous paper.

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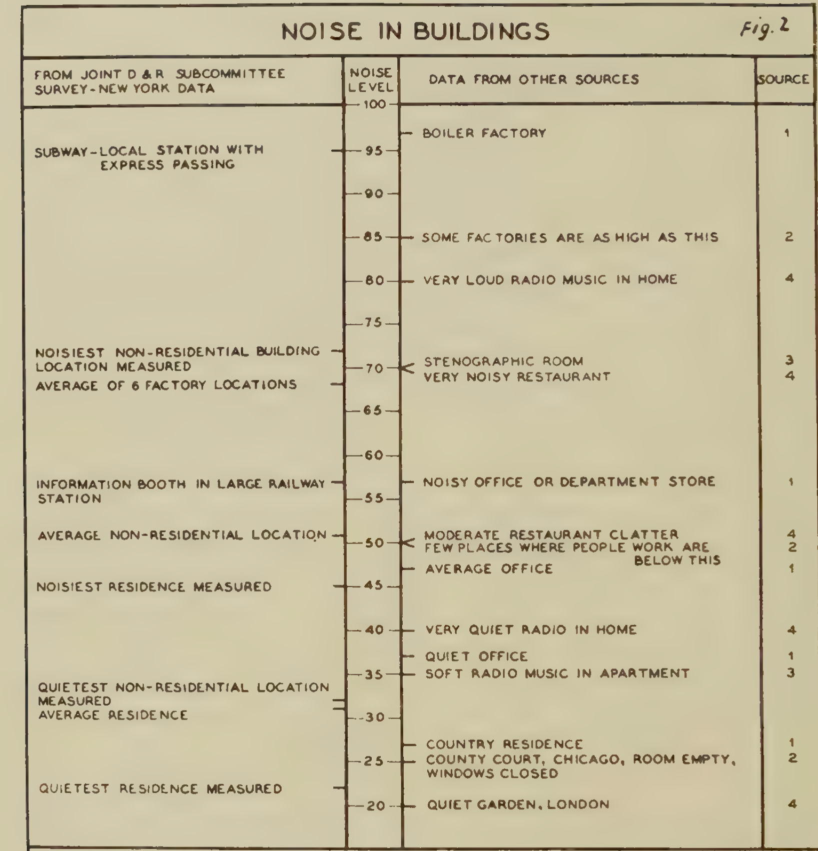
[4] Expressed on the basis employed for the complete survey, these figures would be 36, 45, and 32 db, respectively.



SOURCES:
1. H. FLETCHER, "SPEECH AND HEARING", P. 187. MARGINAL AUDIBILITY METHOD WITH 3A AUDIOMETER AND OFFSET RECEIVER. 17 DB. ADDED AS APPROXIMATE FIGURE TO CONVERT TO NOISE LEVEL.
2. D.A. LAIRD, SCIENTIFIC AMERICAN, DEC. 1928, P. 509. BALANCE METHOD WITH 3A AUDIOMETER AND RECEIVER WITH FLAT CAP. APPROXIMATELY EQUAL TO NOISE LEVEL.
3. W. WATERFALL, ENGINEERING NEWS RECORD, JAN. 10, 1927, P. 60. SAME METHOD AS (2) ABOVE.
4. A. H. DAVIS, NATURE, JAN. 11, 1930, P. 48. BALANCE OR MARGINAL AUDIBILITY METHOD WITH 640-CYCLE TUNING-FORK. FIGURES GIVEN IN TERMS OF SENSATION LEVEL, ESTIMATED EQUAL TO NOISE LEVEL.

Comparison with Other Results

Figure 2 gives on the left some noise levels from these New York measurements, and on the right previously published results by other investigators. These have been converted to noise levels by the use of estimated conversion factors as described in the paper on outdoor noise. The fact that the table is not completely consistent may be explained by possible errors in the conversion factors or by the fact that noises in different locations of the same type may differ.

It will be observed that a tremendous range of noise levels is covered by this table, the maximum levels being nearly as high as for outdoor noise.

The available results of studies of noise in homes and places of work are evidently far from complete. More work is desirable along the lines of general surveys, of studies of different classes of locations and of particular noise sources, and of efforts to ameliorate indoor noise.

The author wishes to acknowledge the work of Messrs. J. W. Whittington of the National Electric Light Association and J. M. Barstow of the American Telephone and Telegraph Company in carrying out the joint survey, and the suggestions of Dr. R. H. Galt of Bell Telephone Laboratories as to presentation of the results.

Relation Between Average Noise Levels in New York City and in Certain Other Localities

In addition to the above which was presented to the Acoustical Society, one other matter may be of interest to the Noise Abatement Commission. In the joint survey conducted by the National Electric Light Association and Bell System, measurements were made in certain other towns and cities in the neighborhood of New York City. These have been divided into the following three groups: B, C, and D.

It will be observed that class D towns are those of smallest population, class C somewhat larger and class B larger still but not as big as New York City. Therefore, a somewhat rough indication of the variation of average noise level with the size of the town in which measurements were made can be obtained from the measurements in these localities, the indication, however, being subject to considerable uncertainty due to the fact that only a small number of measurements were made in each class of town.

The average room noise level for the residential locations where measurements were made in New York City was found

MEASUREMENTS IN OTHER CITIES

Class of Town	Name of Town	Number of Measurements Made Residential Location	Non-Residential Location
Class B	Jamaica, N. Y.	11	11
	Yonkers, N. Y.	3	7
	Total	14	18
Class C	Bloomfield, N. J.	2	0
	East Orange, N. J.	9	7
	Flushing, N. Y.	5	0
	Harrison, N. J.	0	3
	Kearny, N. J.	0	6
	Maplewood, N. J.	10	6
	Milburn, N. J.	1	4
	Mt. Vernon, N. Y.	4	6
	New Rochelle, N. Y.	2	0
	Orange, N. J.	0	4
	Summit, N. J.	2	2
	West Orange, N. J.	2	3
	Total	37	41
Class D	Hollis, N. Y.	7	6
	Madison, N. J.	3	0
	Pelham, N. Y.	1	3
	Richmond Hill, N. Y.	1	2
	Total	12	11

to be practically the same as the corresponding average for these smaller cities or small suburban towns. (The residences visited in New York City consisted largely of apartments on side streets.) For non-residential locations, however, the average room noise level for New York City tended to be greater than that for the smaller places, being in fact, about 15 db above the average for the class D towns.

REXFORD S. TUCKER.

Report of Measurements on Automobile Horns

Abstract

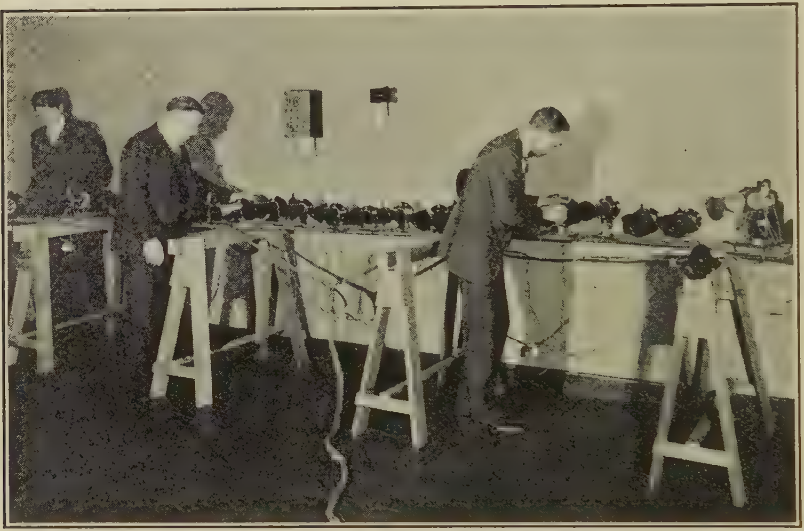
1. In order to override the maximum street noise found in New York, the levels of the sounds emitted by automobile horns should be of an order of 88 to 93 decibels as measured with the noise meter for a reference distance of 23 ft. between horn and microphone. Approximately 50 per cent of the horns tested fall within this range.

2. The sound waves of the least objectionable horns had fundamental frequencies in the range between 200 and 300 cycles and the overtones were all harmonically related to the fundamentals. The levels of sound emitted by these horns fell in the above range of levels. Other things being equal, horns which emit sound waves having only harmonic overtones are less objectionable than horns which emit sound waves having inharmonic overtones. Similarly, horns which emit sound waves having a more or less uniform distribution of sound energy in frequency appear to be less objectionable than horns which emit sound waves having the major portion of the energy distributed in either the lower or the higher frequency ranges.

Introduction

After the formation of the Noise Abatement Commission by Health Commissioner Wynne, the various manufacturers of automobile horns were requested to submit samples of their products for study by the Commission. Thirty-eight horns of various types were received, a sample which probably is representative of automobile horns of today.

The horns were turned over to the Noise Survey and Measurement Committee of the Commission for such measurements as seemed advisable. Two types of physical measurements have been made, namely, the noise levels (measured with the noise meter) of the sounds emitted by the horns, and the acoustic spectra, i. e., the fundamentals and overtones of the complex sound waves of the horns. Judgment tests on the horns were made also. For this purpose a jury was assembled which was composed, for the most part, of members of the Noise Abatement Commission, representatives of the metropolitan press, and representatives of various automotive organizations. The horns were judged with respect to their objectionableness for any reason such as "frightening effect," "raucous tone," etc., and with respect to their ability to override noises simulating heavy traffic in New York.



Photograph by Bell Telephone Laboratories

The line-up of automobile horns tested to develop definite requirements for warning signals.

It is the purpose of this report to give the results of this work and to discuss such relations as are evident between the physical measurements and the judgment tests.

Types of Automobile Horns

For convenience, the horns that were received may be divided into three classes:

1. Motor driven type
    a. electric motor (ten). b. hand motor (two).
2. Vibrator type (twenty).
3. Wind driven type
    a. musical (three). b. so-called compression whistles (three).

The principle of the first type is to drive the diaphragm or sound radiator by means of a small electric motor. A small wheel or disc having studs on its periphery is attached on the shaft of the motor and so arranged that upon rotation the studs strike a boss on the diaphragm. The speed of the motor is such that the diaphragm is struck at rates from 250 to 450 times per second, depending upon the particular horns.

The second type works on the principle of an ordinary electric buzzer or door bell, the armature or vibrating element being connected rigidly to the diaphragm of the horn. One horn that was included in this class operated upon a somewhat different principle. An electric motor was used to vary the magnetic flux through the armature rather than the usual make-and-break spring contact.

The wind driven type works on the principle of any musical horn of the reed type. These horns usually have more than one reed or fundamental frequency. The air pressure needed for operation is obtained by means of an electric motor pump, or in some cases, by suitable connection to the car motor. The three musical horns were quite similar in character. For this reason, and because two of the horns were difficult to operate with available equipment, only one of the horns was included in all of the tests made on motor and vibrator type horns. No tests were made on the three compression whistles.

Levels of Emitted Sounds

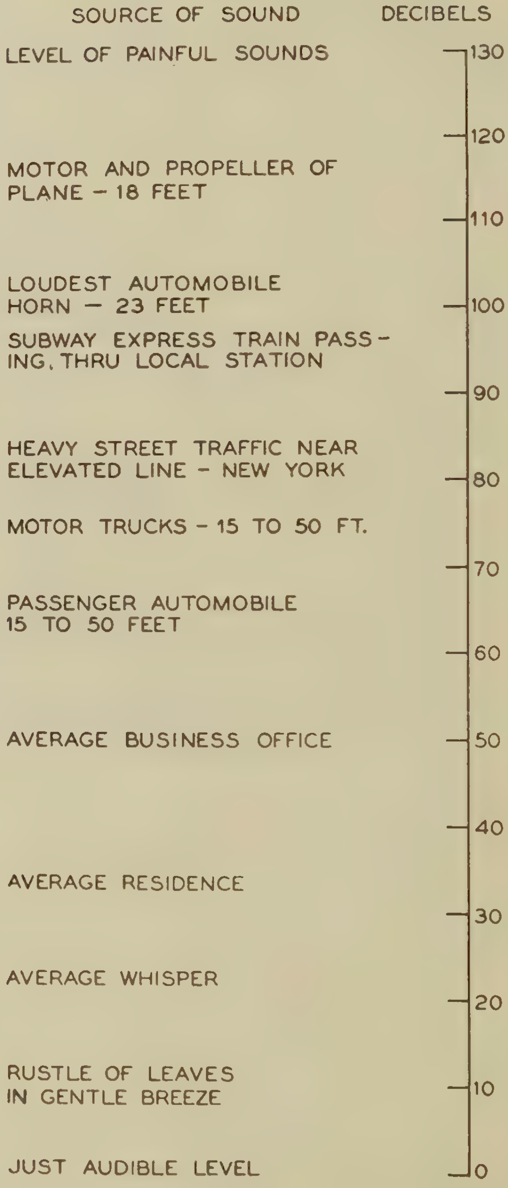
The levels of the sounds emitted by the various horns were measured with the noise meter that was used in the survey of the city's noise. Essentially, this meter consists of a microphone to pick up the sound waves, an amplifier and weighting network, and a suitable thermocouple meter arrangement to indicate the electric current corresponding to the sound waves picked up by the microphone. The instrument is calibrated to give the approximate sensation level, i. e., the level of sound in decibels above the threshold of hearing for such sounds as street noise. A more complete description of the noise meter will be found in the report on pages 120, 121, 122.

LEVELS OF AUTOMOBILE HORNS APPROX. DIST. 23 FT.

HORN NO.	TYPE	LEVEL DECI-BELS
9	V	102
19	M	101
7	V	99
30	V	98
10	M	97
22	V	97
17	V	96
5	V	95
8	V	95
15	M	95
18	M	95
28	V	95
31	V	95
1	V	94
6	V	93
4	V	92
11	V	92
26	V	92
2	M	91
12	V	91
16	M	91
23	M	91
3	M	90
21	M	90
24	M	90
27	V	90
33	HM	89
13	V	88
14	V	87
32	HM	84
25	W	83
20	V	74
29	V	72

TABLE I

THE DECIBEL SCALE



The levels were measured on the roof of the building at 463 West Street so as to obviate the effects of reflected sound waves. The horns were arranged on the arc of a circle at an approximate distance of 23 feet from the microphone. They were operated by means of a storage battery connected to the horns through a master keyboard. The operating voltage across the terminals of the horns was approximately six volts.

The levels of the horns under the above conditions are shown in Table I. The levels of various familiar sounds are also shown in order to orient the scale in the reader's mind. It is evident that automobile horns are loud. The loudest horn had a level of 102 decibels. The lowest level measured was 72 decibels. Only five of the horns had levels less than 88 decibels.

The levels at other distances may be obtained approximately by assuming that the intensities stand in the inverse ratio of the squares of the distances. Thus to obtain the levels for a distance of 11.5 feet from horn to microphone add 6 decibels to the levels of Table I, for a distance of 46 ft. subtract 6 decibels, and for a distance of 92 ft. subtract 12 decibels.

Acoustic Spectra of Horns

The sound waves of automobile horns are complex waves, that is, the wave of a given horn may be resolved into a number of component waves consisting of a fundamental and overtones. An acoustic spectrum is a graph showing the amplitudes and frequencies of the component waves. The spectra of the various horns were obtained by means of a harmonic analyzer[1], a device which resolves a complex electric current into component sinusoidal currents. This is done by passing the complex current through a circuit which can be tuned to various frequencies in the range of interest. Such a circuit primarily responds to currents of frequency equal to the resonant or tuned frequency of the circuit. By changing the tuning the various component currents are selected from the complex current.

The acoustic waves emitted by the horns were picked up by means of a microphone placed at a distance of two feet from the horns in a well damped room. Under these conditions the effects of reflected waves were negligible. The complex voltage generated by the microphone was suitably amplified and transmitted

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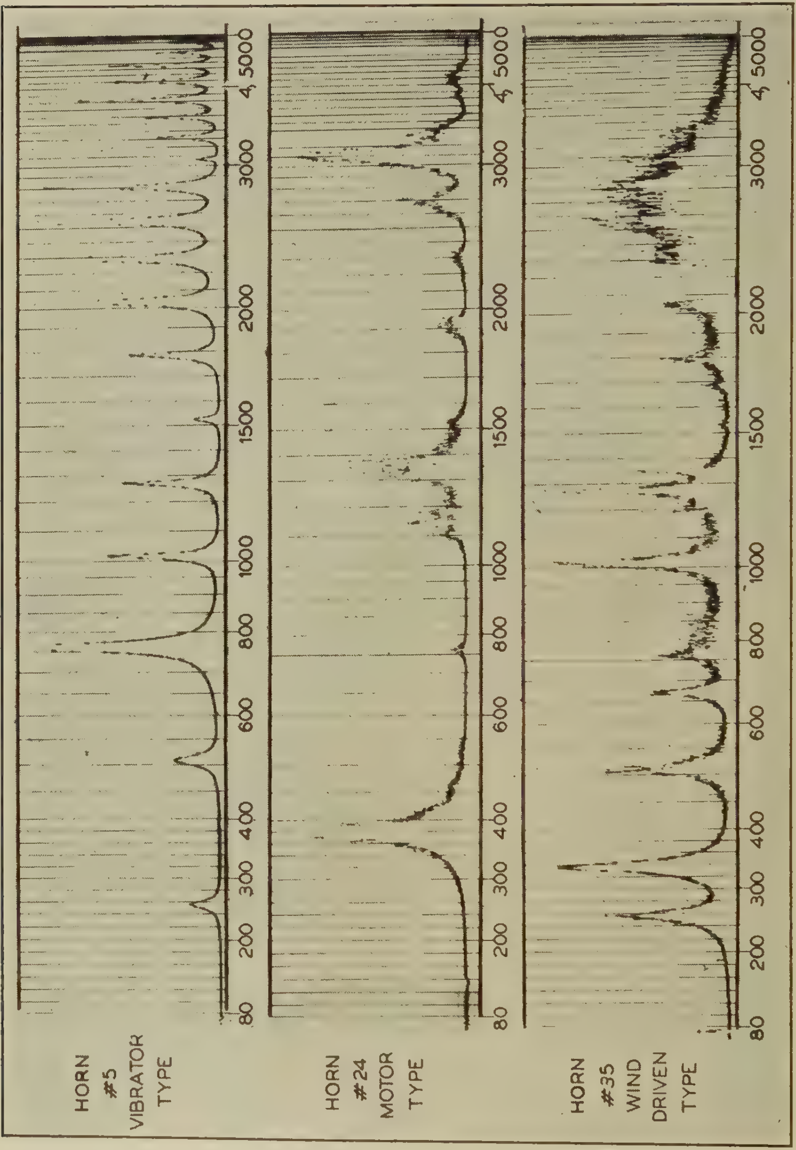
[1] An Electrical Frequency Analyzer, R. L. Wegel & C. R. Moore, B.S.T.J., Apr. 1924.

Fig. 1



to the harmonic analyzer for analysis. From the known amplification of the system and a suitable calibration of the microphone the readings of the harmonic analyzer were expressed in units of sound pressure, i. e., in bars or in dynes per square centimeter. Corrections were made for the effects of introducing the microphone into the sound field, so that the pressures given approach those that would be produced by the horns over a square centimeter of wave front at a distance of two feet directly in front of the horns.

Before taking up the acoustic spectra, it will be of interest to examine the current spectra that were obtained from the harmonic analyzer. Fig. 1 shows three current spectra that are typical of the three types of horns studied. These spectra show the response of the analyzer to the applied waves when tuned to various frequencies in the range between 80 and 5,000 cycles. They are photographs of a spot of light that is reflected from the mirror of a galvanometer, the deflection of the galvanometer being an indication of the response of the analyzer. The frequencies of the peaks in the spectrum of the vibrator type are all integral multiples of the lowest or fundamental frequency. The peaks in this spectrum show a succession of black dots which indicate that the response of the analyzer changes when tuned to slightly different frequencies, but during the time it is tuned to a given frequency its response is perfectly steady. The spectrum of the motor type shows neither of these properties. Not only are there inharmonic as well as harmonic overtones present, but the response of the analyzer when tuned to a given frequency constantly fluctuates up and down. This fluctuation is due to the presence in the wave of components or overtones of nearly the same frequency which are not resolved by the tuned circuit of the analyzer. When this is the case they beat together causing the galvanometer to fluctuate rather than take a steady position. As may be seen from the spectrum, some of these groups of components of nearly the same frequency, cluster about a frequency which is a harmonic of the fundamental. In the case of other groups, e.g., the one between 1300 and 1400 cycles, the group frequency is inharmonic. It is probable that the inharmonic components are produced because the diaphragm is not constrained to move in accordance with the driving cam, and that the load on the motor varies somewhat with the average position of the diaphragm when vibrating.

The wind driven horn was of the two horn type, each horn having its own fundamental frequency, namely, the two lowest frequencies shown in the spectrum. In this case, the group frequencies present are all integral multiples of one or the other of these fundamental frequencies. The presence of inharmonic components in the sound waves of this horn is probably due to the reed action, the reed being of the Venturi hinge type.

Spectra of the above type together with a calibration of the apparatus enabled an acoustic spectrum to be obtained for each horn. These spectra are shown in Figs. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11. The frequencies of the fundamentals and overtones are indicated by their positions along the horizontal axis. The amplitudes are indicated by the heights of the lines. For convenience, a decibel scale is used, zero decibels corresponding to an acoustic pressure of 0.1 bars.[2] To represent the characteristics discussed above, the following conventions have been adopted: (a) the fundamentals and the overtones which are harmonics of the fundamentals are indicated by solid lines, (b) inharmonic overtones are represented by dashed lines, (c) the presence of overtones of nearly the same frequency is indicated by dotted extensions of the lines, the lengths of the dotted portion indicating the extent of fluctuations.

Each spectrum shows the amplitudes of the fundamental and overtones in the frequency range from 80 to 5000 cycles. The indicated values of amplitude for the more important components may be in error by as much as 5 db. The smaller components, i. e., the smallest one on each chart and those within 5 db of the smallest one may be less than the indicated value by 20 db, but are not likely to exceed the indicated values by more than two db or so.

The spectra for the vibrator type horns show that the overtones are harmonics of the fundamental frequencies. Except in the case of a few horns, the overtones of greatest amplitude occur in the frequency range above 2000 cycles. The amplitudes of the

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[2] $db = 20 + 20 \log_{10} P$, where P=pressure in bars.

Fig. 2

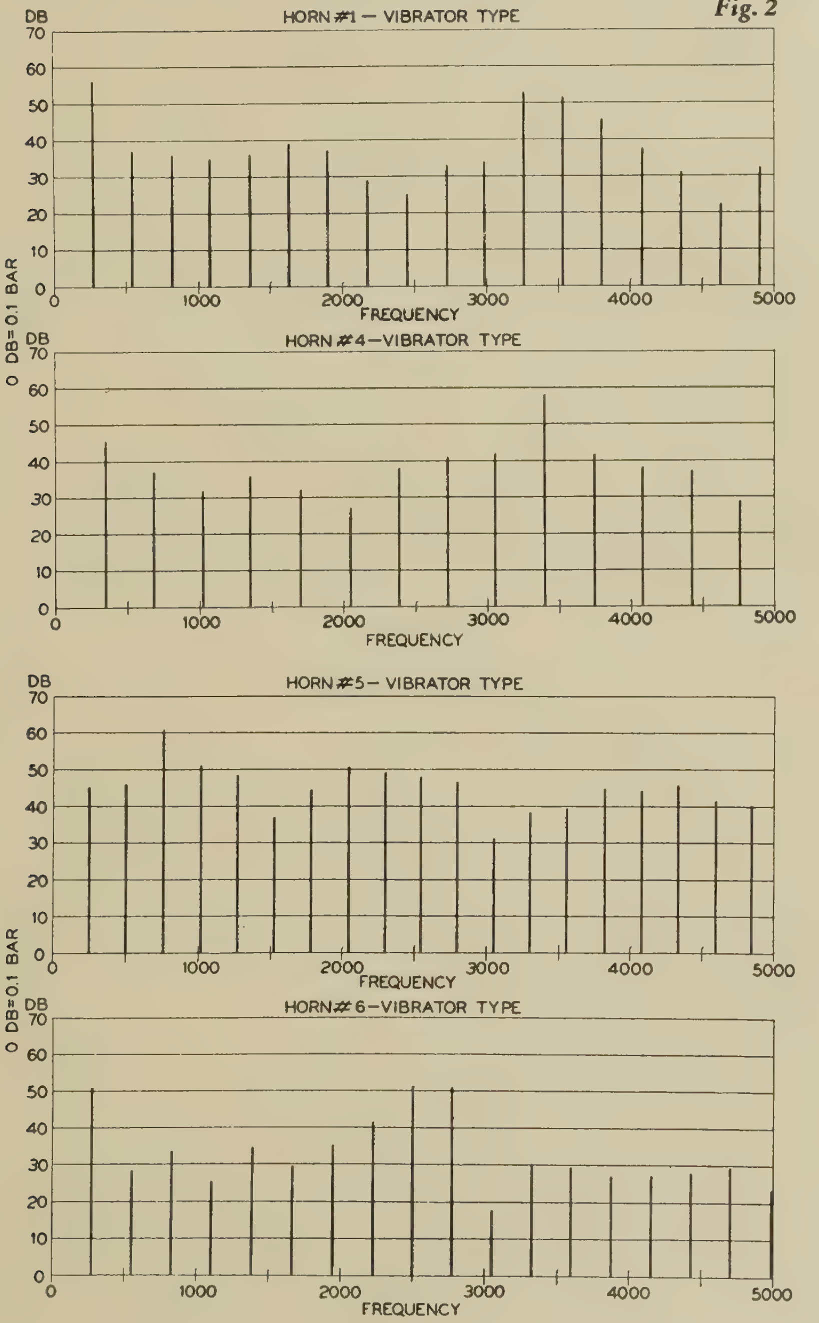

HORN #1 — VIBRATOR TYPE
HORN #4—VIBRATOR TYPE
HORN #5— VIBRATOR TYPE
HORN # 6—VIBRATOR TYPE
DB
0 DB = 0.1 BAR
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
FREQUENCY

Fig. 3

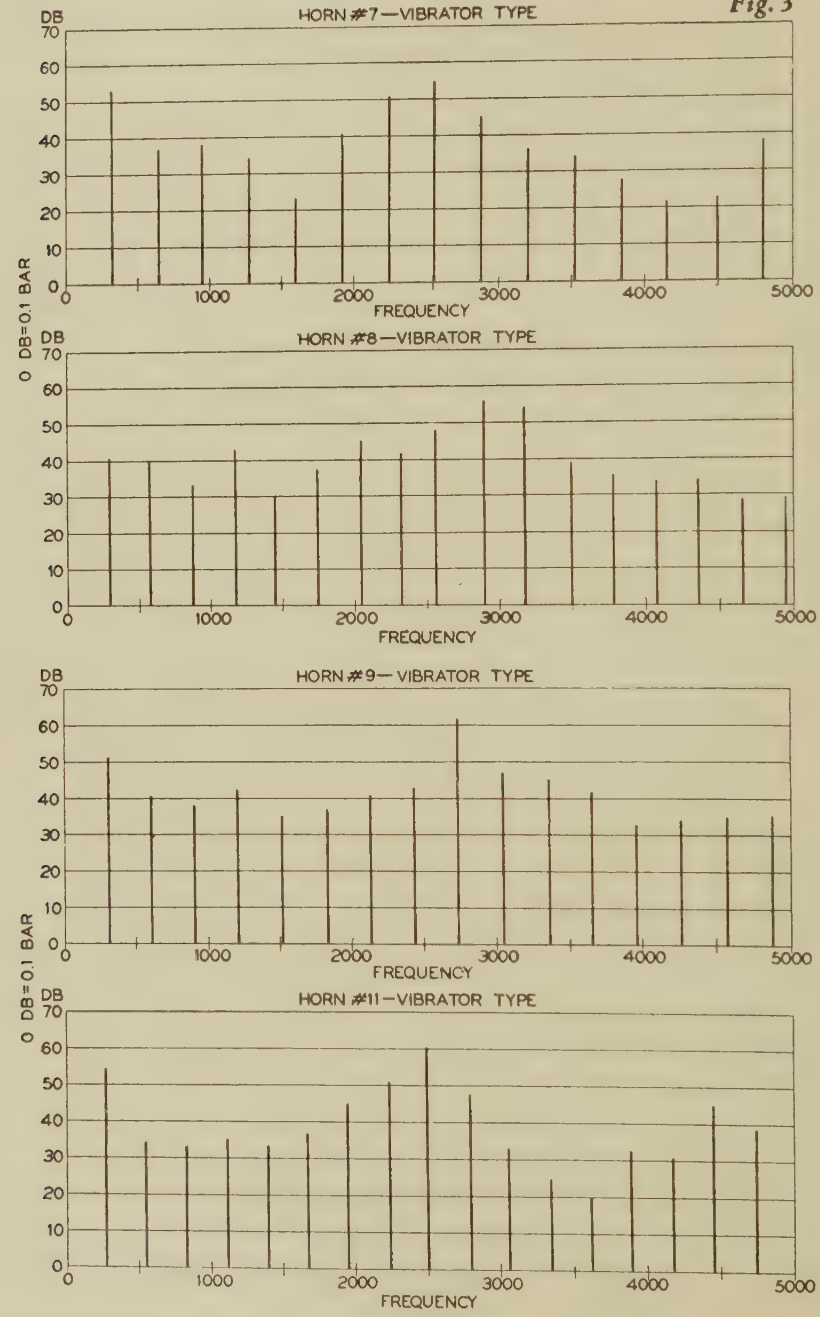

HORN #7—VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY
0 DB=0.1 BAR
HORN #8—VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY
HORN #9—VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY
0 DB=0.1 BAR
HORN #11—VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY

Fig. 4

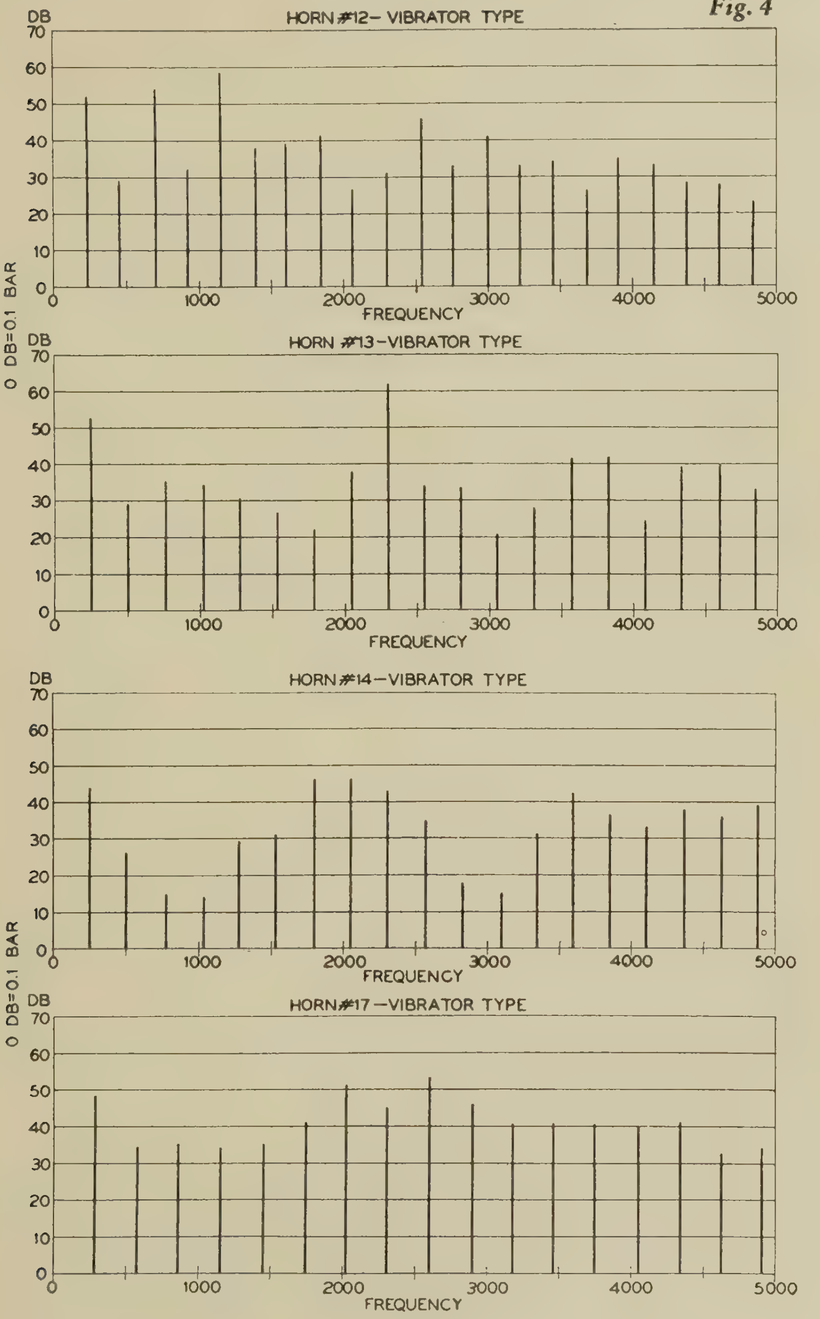

HORN #12– VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0 DB=0.1 BAR
0
1000
2000
3000
4000
5000
FREQUENCY
HORN #13–VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY
HORN #14–VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0 DB=0.1 BAR
0
1000
2000
3000
4000
5000
FREQUENCY
HORN #17–VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY

Fig. 5

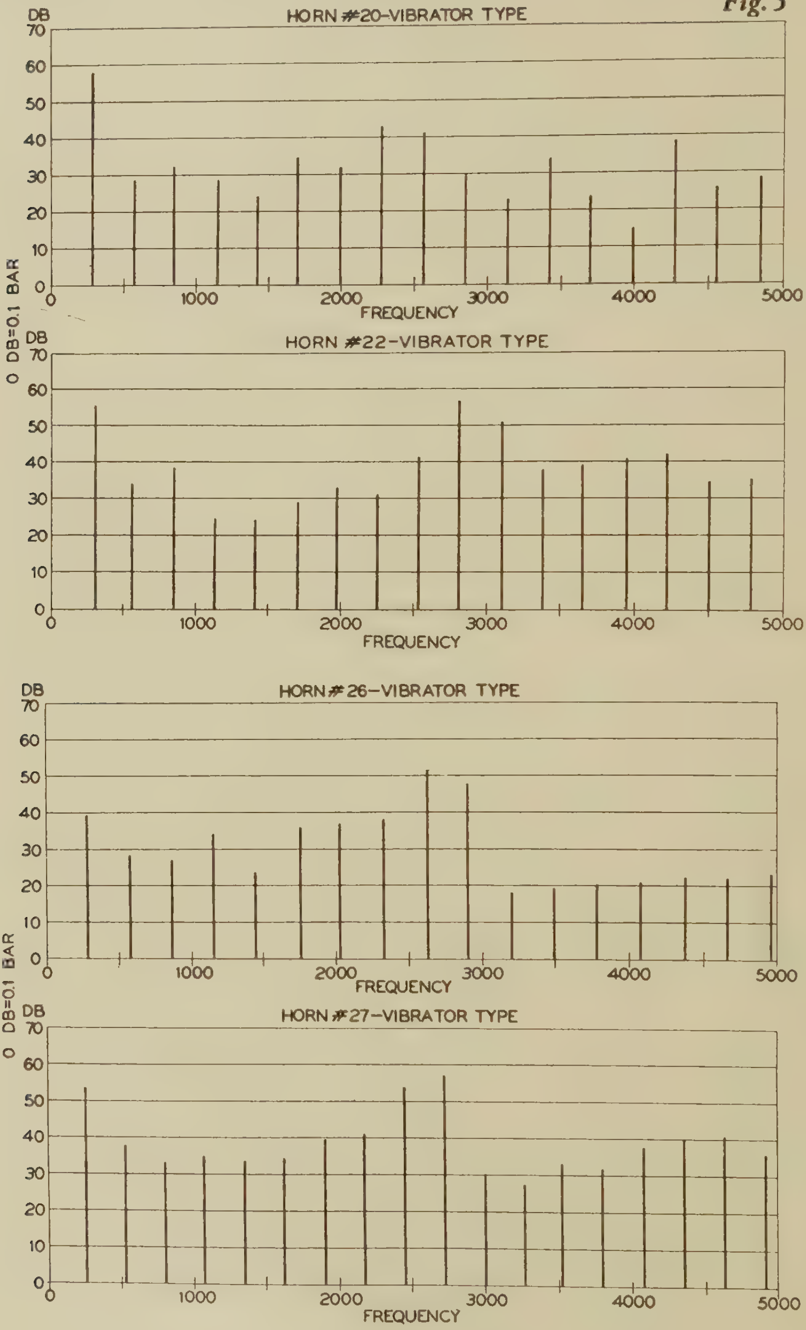
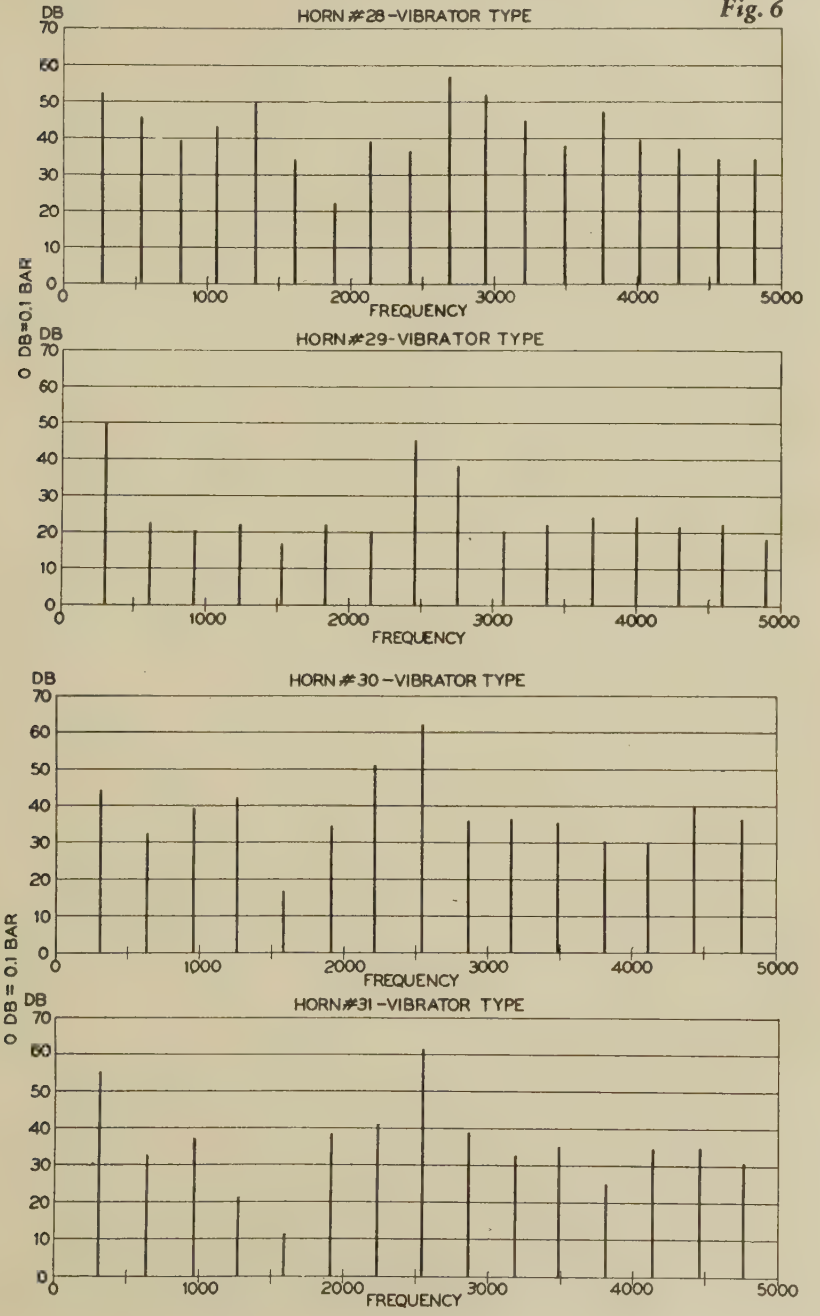

HORN #20-VIBRATOR TYPE
HORN #22-VIBRATOR TYPE
HORN #26-VIBRATOR TYPE
HORN #27-VIBRATOR TYPE
DB
70
60
50
40
30
20
10
0
0 DB=0.1 BAR
0
1000
2000
3000
4000
5000
FREQUENCY

Fig. 6


HORN #28-VIBRATOR TYPE
HORN #29-VIBRATOR TYPE
HORN #30-VIBRATOR TYPE
HORN #31-VIBRATOR TYPE
DB
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
FREQUENCY
0 DB = 0.1 BAR

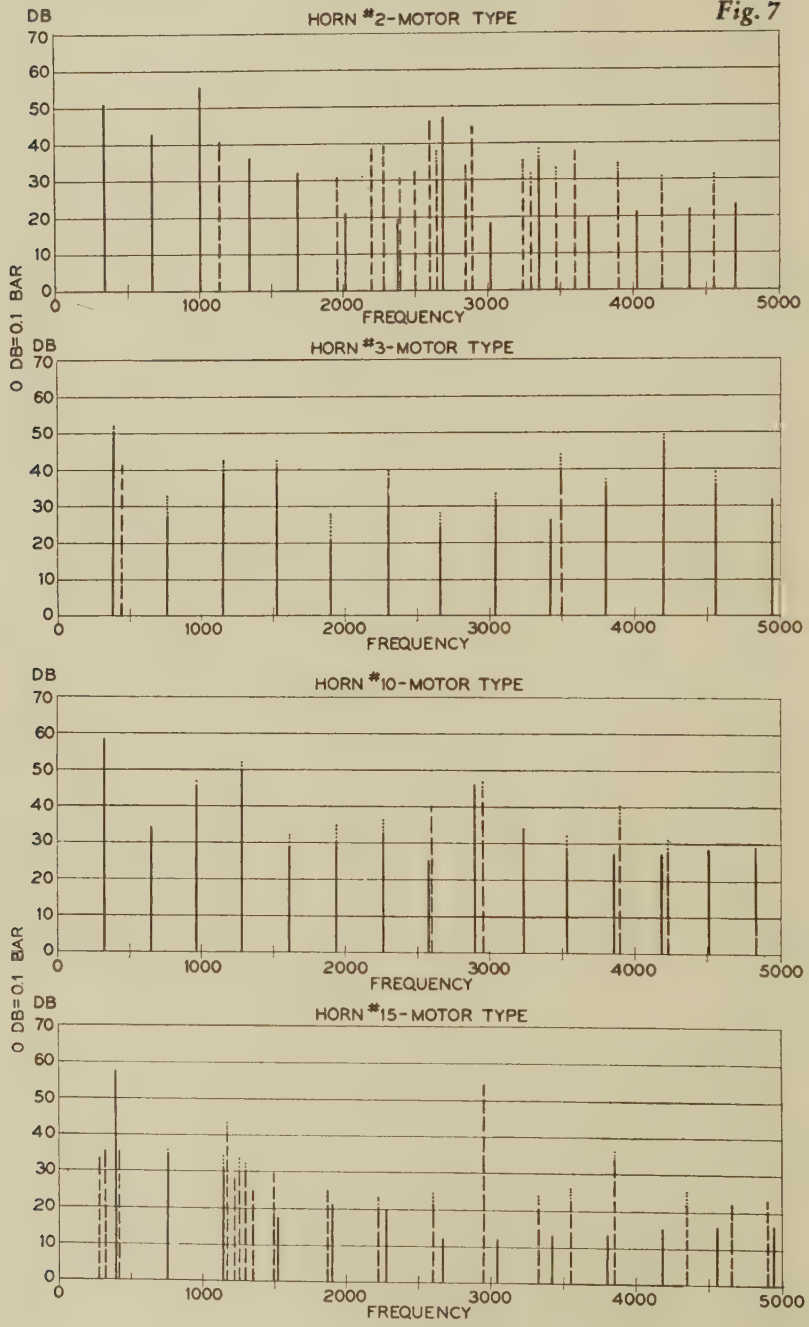


Fig. 7

HORN #2-MOTOR TYPE

HORN #3-MOTOR TYPE

HORN #10-MOTOR TYPE

HORN #15-MOTOR TYPE

Fig. 8

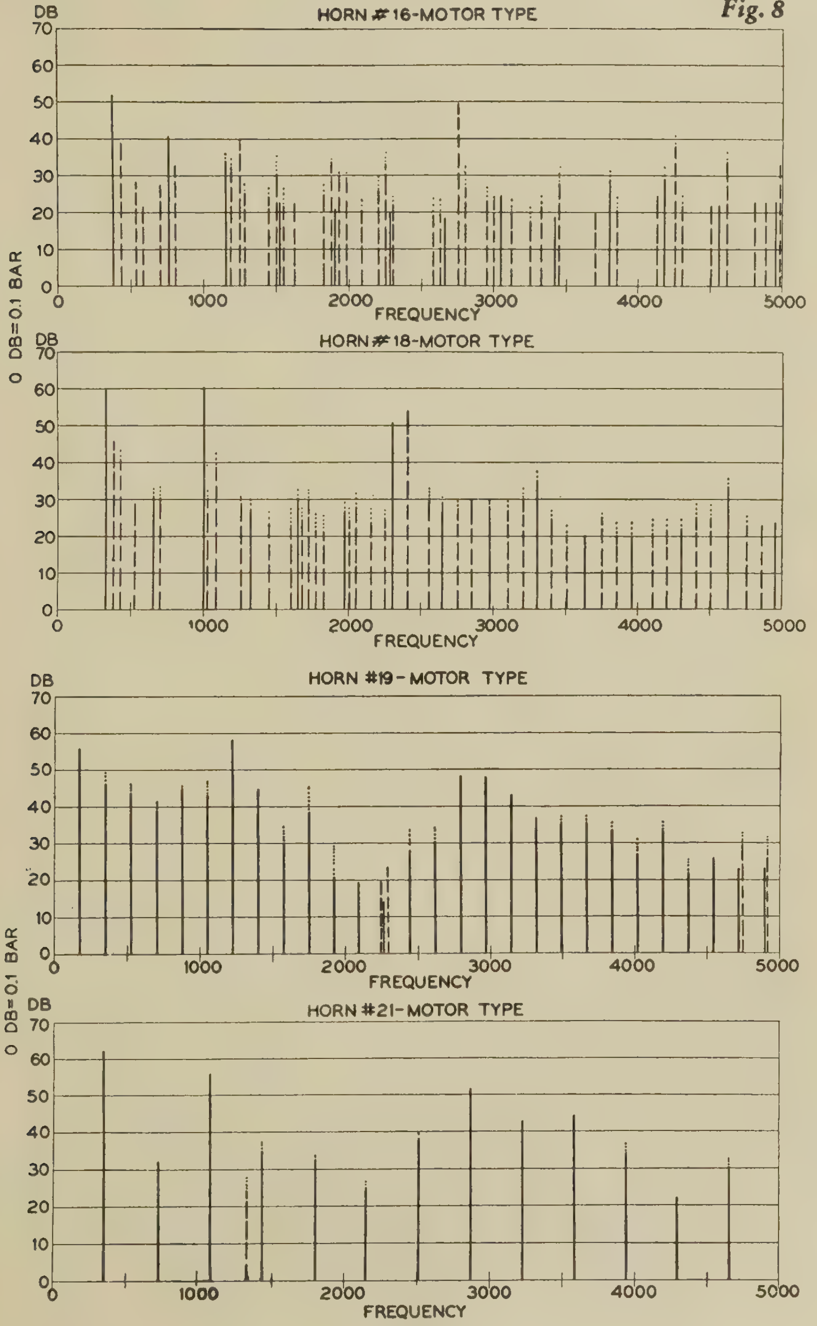

HORN #16-MOTOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY
0 DB=0.1 BAR
HORN #18-MOTOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY
HORN #19-MOTOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY
0 DB=0.1 BAR
HORN #21-MOTOR TYPE
DB
70
60
50
40
30
20
10
0
0
1000
2000
3000
4000
5000
FREQUENCY

Fig. 9

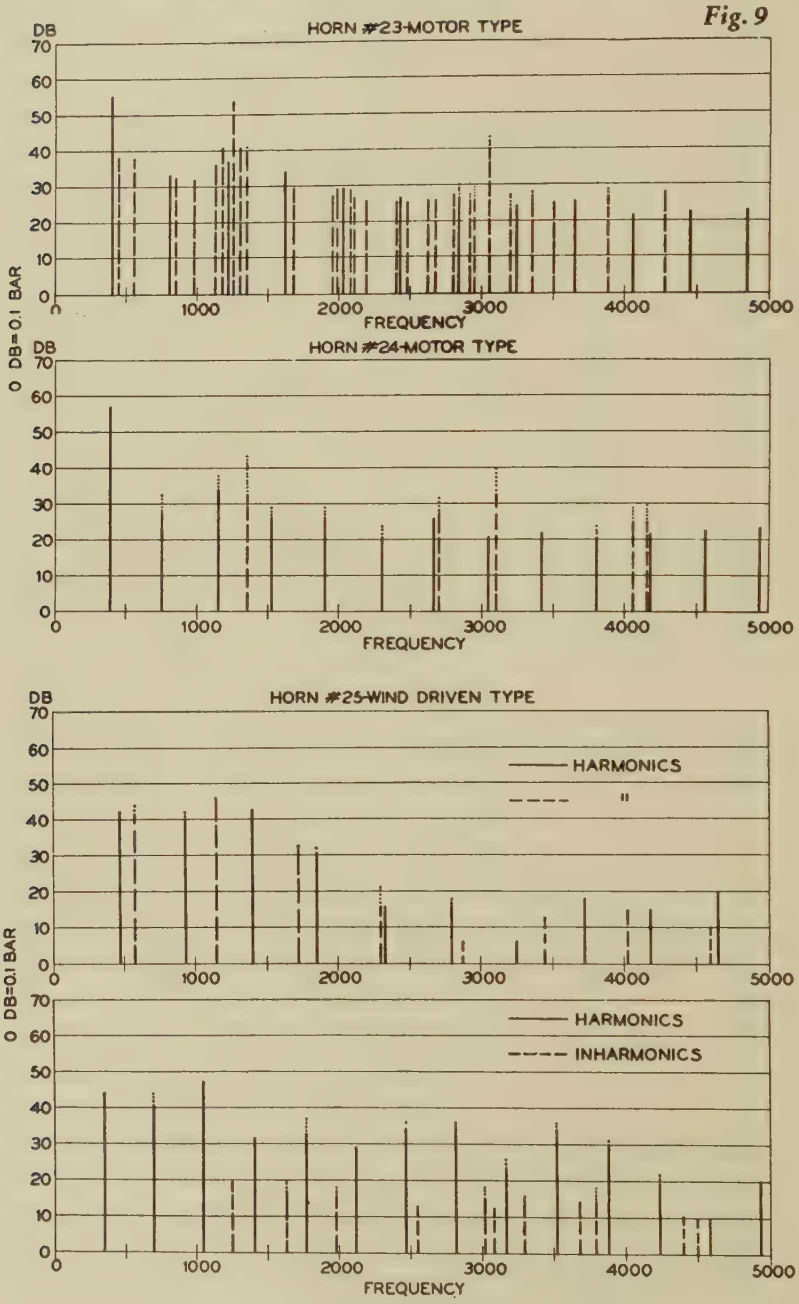
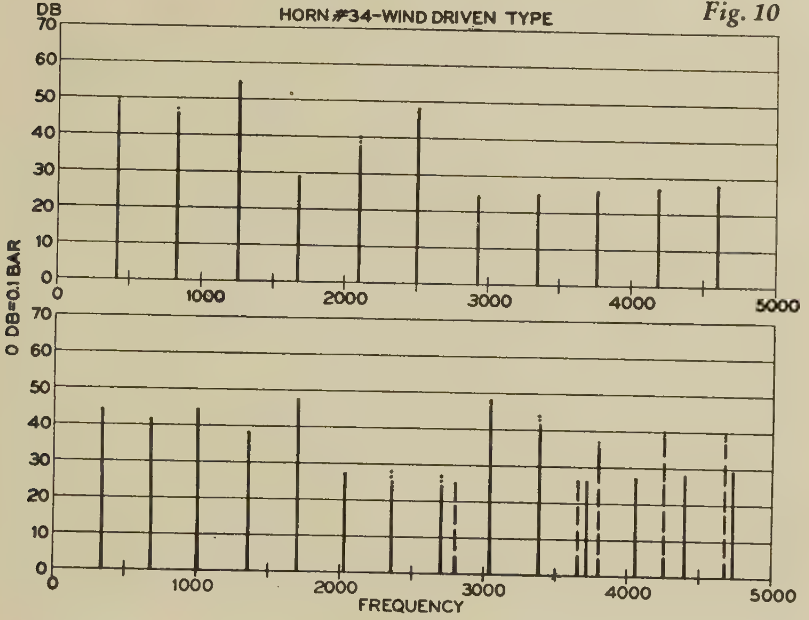
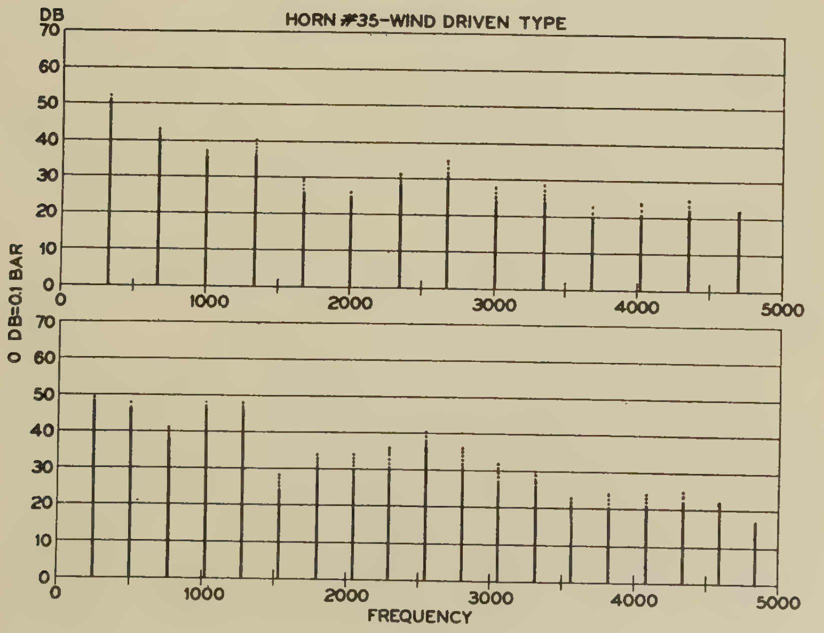

HORN #23-MOTOR TYPE
HORN #24-MOTOR TYPE
HORN #25-WIND DRIVEN TYPE
DB
0 DB=0.1 BAR
0
10
20
30
40
50
60
70
0
1000
2000
3000
4000
5000
FREQUENCY
HARMONICS
"
HARMONICS
INHARMONICS

Fig. 10



HORN #34–WIND DRIVEN TYPE

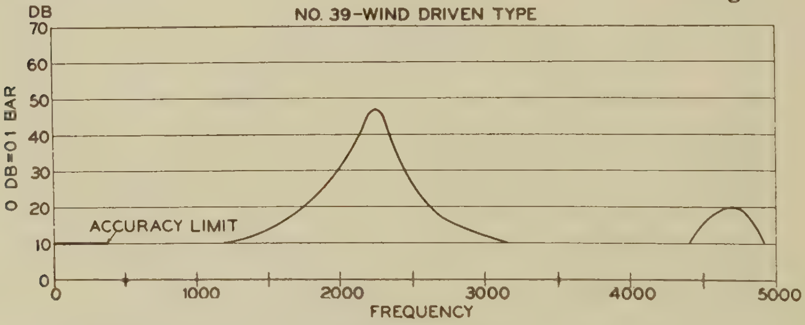


HORN #35–WIND DRIVEN TYPE

overtones in the range between 700 and 2000 cycles are comparatively small. The spectra for the motor type show both harmonic and inharmonic overtones. In some cases overtones of nearly the same frequency (as indicated by the dotted portions of the lines) are grouped around a frequency that is a harmonic of the fundamental. In other cases, such overtones appear to be grouped around inharmonic frequencies. As with the vibrator type, overtones of large amplitude occur in the range above 2000 cycles, although most of the motor type also have an overtone or two of large amplitude near 1000 cycles.

Since the wind driven type horns had more than one fundamental frequency, each fundamental and its overtones are shown as separate spectra. In the case of horn No. 25 two such spectra are shown on the upper chart, one by solid lines, the other by dashed lines. The lower chart shows the spectrum for a third fundamental and such inharmonic overtones as appeared. It will be seen that wind driven horns differ from the preceding types in that overtones of large amplitude occur in the range below 2000 cycles.

Fig. 11



No. 39 shows the spectrum of a police whistle. It consists of a group of components near a frequency of 2300 cycles and a smaller group near a frequency of 4600 cycles. The resolving power of the analyzer was not sufficient to separate the individual components in the group so that it traced an approximate envelope of the amplitude frequency distribution. The analyzer responds in this manner also to the overtones that are shown with dotted portions in the above spectra. In these cases, however, the group of overtones of nearly the same frequency have large amplitudes in a small portion of the frequency range only and the analyzer does not give even an approximate notion of the envelopes of the amplitude frequency distributions.

Judgment Tests of Horns

The object of the judgment tests was to classify the horns approximately, with respect to their objectionableness when sounded near an observer, and with respect to their ability to override the noises occurring on New York streets. The horns were lined up along one side of a large well damped soundproof room. They were operated through a master key board so that one horn after another could be sounded. The horns were assigned numbers for identification and when a particular horn was sounded a small lamp lighted near the number assigned to the horn.

In one of the tests, the jury[1] sat in the room where the horns were sounded at a distance of about twenty feet from the horns. Measurements at this location showed that the levels of the sounds heard by the jurors corresponded to an out-of-door distance of approximately ten feet between horn and listener.

In the other tests, the sounds from the horns were picked up by a microphone and reproduced by means of a loud speaking system in an adjoining room. The amplification of the system was set such that the levels of the reproduced sounds corresponded to an out-of-door distance of approximately 40 feet.

The jury was made up for the most part of members of the Noise Abatement Commission and representatives of the metropolitan press. The tests were made under the following four conditions:

Test I. Effective distance between horn and listener about 10 ft. The participants checked the numbers of those horns which

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[1] Those present at the "jury" test were: Commissioner Shirley W. Wynne, Lewis H. Brown, Edward F. Brown, Professor Albin H. Beyer, Dr. Harvey Fletcher, Dr. Bernard Sachs, Dr. Foster Kennedy, Charles C. Burlingham, Alfred H. Swayne, E. B. Dennis, Jr.—of the Noise Abatement Commission; R. V. Parsons, Karl Meyer, John Parkinson—of the Johns-Manville Corporation; Lonsdale Green, Jr. of the Acoustical Construction Corporation; H. H. Crane of the General Motors Corporation; R. S. Armstrong and Fred D. Hastings of the National Automobile Chamber of Commerce; P. B. Findley of the Bell Telephone Laboratories; Carl Johnson and C. B. Veal of the Society of Automobile Engineers; G. E. Pendray; representatives of the following New York newspapers: Evening World, Telegram, Sun, Herald-Tribune, Mirror, Brooklyn Daily Eagle, Post, Morning World, Times, American.

TABLE II

SUMMARY OF JUDGMENT TESTS OF AUTOMOBILE HORNS

Horn No.	Level 23 ft.	Type	Test 1 – Effective distance 10 ft.– no street noise																						Test 2 – Effective distance 40 ft.– no street noise																						Test 3 – Effective distance 40 ft.– street noise 80 db																					
			observers																						observers																						observers																					
			a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v
1	94	vibrator	✓	✓	✓		✓	✓	✓		✓	✓	✓				✓	✓			✓					✓	✓							✓						✓																											
2	91	motor	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓																							
3	90	"			✓		✓	✓		✓		✓	✓				✓	✓	✓	✓			✓	✓			✓	✓						✓	✓						✓	✓	✓	✓	✓	✓							x															
4	92	vibrator			✓	✓			✓		✓	✓	✓				✓	✓		✓			✓				✓		✓		✓			✓						✓		✓			✓		x			x																		
5	95	"			✓	✓			✓	✓		✓			✓		✓	✓					✓				✓	✓	✓	✓		✓		✓			✓		✓	✓					✓																							
6	93	"		✓							✓	✓					✓						✓			✓								✓											✓																							
7	99	"			✓		✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓		✓	✓																						
8	95	"	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓				✓			✓		✓	✓	✓	✓		✓	✓					✓	✓	✓	✓			✓																							
9	102	"			✓		✓		✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	✓																						
10	97	motor		✓	✓		✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓		✓					✓	✓	✓	✓	✓	✓	✓	✓																						
11	92	vibrator			✓						✓	✓					✓	✓					✓				✓		✓						✓					✓	✓					✓																							
12	91	"																		—	—	—	—																				–	–	–	–			x													x			–	–	–	–	
13	88	"			✓													✓					✓				✓																			✓																						
14	87	"			✓							✓	✓				✓	✓		✓														✓						✓		✓													x												x	
15	95	motor				✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓			✓	✓			✓	✓				✓		✓			✓		✓	✓	✓	✓	✓		✓	✓																						
16	91	"			✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓					✓	✓	✓	✓	✓	✓	✓	✓																						
17	96	vibrator			✓		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓		✓			✓				✓		✓		✓			✓						✓		✓			✓			x																				
18	95	motor	✓		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																						
19	101	"		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓		✓	✓		✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓																						
20	74	vibrator																			✓																											x					x			x	x		x	x			x	x	x	x	x	x
21	90	motor			✓	✓	✓		✓	✓		✓	✓		✓		✓	✓	✓	✓	✓		✓					✓	✓		✓	✓		✓	✓				✓	✓	✓	✓	✓		✓																							
22	97	vibrator	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓				✓				✓	✓	✓		✓			✓				✓	✓	✓	✓	✓			✓																							
23	91	motor			✓	✓	✓		✓	✓		✓	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓					✓			✓		✓	✓	✓	✓	✓	✓																								
24	90	"			✓				✓	✓		✓	✓				✓	✓		✓	✓		✓				✓	✓				✓		✓	✓				✓	✓		✓			✓										x													
25	83	wind																	✓			✓																				✓		✓	✓				x																				x
25A	82	"										✓							✓								✓							✓							✓							x																				x
26	92	vibrator	✓		✓		✓		✓	✓		✓	✓		✓	✓	✓	✓					✓					✓	✓		✓			✓						✓																												
27	90	"			✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓		✓				✓	✓	✓		✓		✓	✓	✓		✓	✓	✓	✓	✓				✓																							
28	95	"			✓	✓	✓		✓		✓	✓	✓		✓	✓	✓	✓	✓		✓		✓				✓		✓					✓					✓	✓	✓	✓			✓																							
29	72	"																									✓																				x					x		x	x	x	x			x	x		x			x	x	x
30	98	"	✓		✓	✓		✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓			✓	✓			✓		✓	✓	✓				✓		✓	✓		✓	✓																							
31	95	"	✓		✓			✓	✓		✓	✓			✓	✓	✓	✓	✓		✓		✓				✓	✓		✓	✓	✓	✓	✓					✓	✓	✓			✓																								
32	84	motor(hand	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓																						

✓ = objectionable
x = inadequate

in their judgment would cause an objectionable frightening or startling effect on people.

Test II. Effective distance 40 ft. The various horns were sounded and the participants checked those horns which in their judgment were objectionable.

Test III. Effective distance 40 ft. The horns were sounded in the presence of reproduced street noise at a level of 80 decibels. This level corresponds to the noise level caused by heavy traffic. For purposes of this test, a phonograph record of street noise was reproduced in the room by means of a loudspeaking system. The level of the noise in the room was measured by means of the noise meter. The participants checked those horns which in their judgment were not sufficiently loud to override the noise.

Test IV. Effective distance 40 ft. In this test a 4000 cycle low pass filter was associated with the loud speaking system. When the filter was inserted the overtones above 4000 cycles were eliminated from the sound waves of the horns. The participants alternately listened to the original or unfiltered sound and the modified or filtered sound, and checked the sound (filtered or unfiltered) which they preferred.

The individuals' checks on the horns are shown in Table II for tests I, II and III. Since Tests I and II were very similar, the results of these two tests have been combined and are shown in Table III arranged in the order of decreasing numbers of objectionable votes, together with the levels of the horns that were given in Table I.

The results shown in the two tables may be summarized as follows:

1. The average level for the eight most objectionable horns is some 12 db greater than the average level for the eight least objectionable horns.

2. With two exceptions, the spectra for the eight most objectionable horns show harmonic and inharmonic overtones, and the spectra for the eight least objectionable horns show harmonic overtones only.

TABLE III.

Summary of Judgment Tests on Automobile Horns

Horn No.	Type	Objectionable Votes No.	Level at 23 ft.
32	M.H.	41	84
18	M	40	95
2	M	38	91
19	M	36	101
10	M	33	97
16	M	33	91
7	V	31	99
9	V	31	102
27	V	29	90
30	V	29	98
33	M.H.	29	89
8	V	28	95
23	M	27	91
15	M	26	95
21	M	26	90
22	V	26	97
31	V	24	95
3	M	21	90
28	V	21	95
17	V	20	96
5	V	19	95
24	M	19	90
4	V	17	92
26	V	17	92
1	V	16	94
11	V	12	92
14	V	9	87
6	V	8	93
13	V	5	88
25	W	5	83
25A	W	5	82
20	V	1	74
29	V	1	72
12	V	0	91

V=vibrator type, M=motor type, M.H.=hand motor type, W=wind driven type.

Total number of objectionable votes possible=44.

3. Only one horn received no objectionable votes, and two horns received one objectionable vote each. The two latter horns, however, due to their low levels were voted inadequate to override street noise. Part of the test on horn No. 12, the one receiving no objectionable votes was discarded because of faulty operation of the horn.

In test IV, the jury almost unanimously preferred the modified sound, i. e., the sound with all overtones above 4000 cycles eliminated, to the unmodified sound from the horns. In a few cases the two sounds were judged equally preferable.

Discussion of Results

There appear to be several factors that influenced the jury's vote on the objectionableness of the different horns. One was level; horns that emitted sounds of very great level were objectionable irrespective of the character of the sound. The presence of inharmonic overtones in the sound waves of horns also caused them to be objectionable. With one or two exceptions, all of the motor driven horns were objected to by a majority vote of the jury. The sound emitted by the two horns that were exceptions was of comparatively low level. How the sound energy is distributed in frequency, that is, how the amplitudes of the overtones vary with frequency, also influenced the jury's judgments on the horns. Overtones of relatively large amplitude in the frequency range above 2000, 3000, 4000, or 5000 cycles cause the sound to have a sharp disagreeable character. Overtones of relatively large amplitude in the frequency range below 1000 or 2000 cycles cause the sound to have a more musical character. In either case, the presence of inharmonic overtones introduces a raucous or raspy character into the sound. Such overtones are always present when the wave form of the sound is not exactly recurrent.

It is possible to form some estimate of the level needed by horns for use in the metropolitan area from the noise measurements that were made on the streets of New York. To be adequate as a signal, the level at the observers ears, of the sound from a horn must be great enough to positively override the noise which the observer hears. The level of street noise at a given location varies from instant to instant passing through maxima and minima values. The greatest average noise level, i. e., averaged over a period of ten or fifteen minutes, measured during the survey was 78 decibels, and it occurred at a location near an elevated railway where street traffic was very heavy. Although the instant to instant variations of noise level may exceed this figure by as much as 5 or 10 decibels, the variations are of short duration, so that it seems reasonable to take the figure of 78 decibels as representing the extreme of noise levels on the streets.

The sound from a horn will be just audible in the presence of this amount of noise if it reaches the observers ears at a level of about 63 db. The votes registered in Test III of Table II against the two horns that produced sounds of about this level in the presence of 80 decibels of noise indicate that this level was not great enough to be adequate as a warning. Although a few scattered votes were registered against horns producing sounds of higher levels, the tests were not accurate enough to indicate a level that would be adequate as a warning signal in the presence of 80 decibels of noise. In the absence of direct data it seems reasonable to assume that an adequate level would be 78 decibels, or a level equal to that of the noise. In this case, the sounds from horns would in general be clearly audible in the presence of the noise, so that, if the assumption is in error, the error would be in the direction of requiring a higher horn level than might be considered necessary by an average observer. It should be pointed out that these considerations apply to individuals having a moderate degree of deafness as well as to individuals of normal hearing.

The level needed by a horn to produce a sound level of 78 decibels to an observer depends upon the distance between the car and the observer at the time the horn is sounded. It seems reasonable to take a distance of 92 feet as a suitable warning distance. Cars traveling with speeds of 35 to 15 miles per hour would traverse this distance in approximately two to four seconds. To fulfil these requirements, the level of a horn for the distance at which the horn levels were measured, i. e., 23 ft., should be 90 decibels.

Allowing for a 5 db spread, the above considerations indicate that horns should produce sound levels of 88 to 93 decibels for the reference distance (23 ft.). The measured levels for the 34 horns (Table I) show that 45 per cent of the horns produced levels in excess of this range, the levels of 42 per cent fell within the range and the levels of 13 per cent were below the range.

It is of interest to compare these levels with the levels of sounds from horns as actually observed on the streets of New York during the survey. The average of some 80 observations on the levels of sounds emitted by auto horns on New York streets is 72 decibels. In these observations the distance between the source and the microphone ranged from 25 to 100 ft. The average level for the 34 horns discussed above is 91 decibels for the reference distance of 23 ft., or 90 to 78 decibels for distances of 25 to 100 ft. The average level observed on the streets is lower by six decibels than the level that would be expected for even the maximum distance of 100 ft. Probably the chief reason for this difference lies in the fact that the observations on the streets were not made directly in the path of the approaching car. Some of the cars, for example, may have been traveling away from the noise truck, or at right angles to the noise truck when the observations were made. In view of this, it would be expected that reference levels of 88 to 93 decibels would cause a warning level of 78 decibels to an observer 96 ft. away only when the observer is in the path of the approaching car.

On the matter of inharmonic overtones, it seems clear that their presence in the sound waves of auto horns causes the sound to be objectionable. There is nothing to indicate that their presence adds in any way to the purpose of the horn.

The tests that have been made do not indicate definitely how the sound energy should be distributed in frequency in order to obtain a least objectionable sound. Musical horns represent one extreme. Some of the flat vibrator type which do not have horns and produce a very sharp shrill sound represent the other extreme. Many people object to the musical horns on the grounds that after all an auto horn is an auto horn and should produce a sound that is characteristic of an auto horn. On the other hand, horns producing very shrill sounds are objectionable to many people. In the judgment tests previously described the following four horns, Nos. 6, 12, 13, 14, all of the vibrator type, stood out as being satisfactory (in comparison with the others) to 80 percent of the jury under all of the conditions of test. Examination of the acoustic spectra of these horns shows them to be in between the two extremes cited above. The filter test showed that the sound from even these horns could be made less objectionable by eliminating all overtones above 4000 cycles. A few additional filter tests, in which all overtones above 2000 and 3000 cycles were eliminated, were also made with part of the jury. No vote was taken but informal discussion indicated that there was a limit to this procedure also. All of those participating appeared to prefer the sound with overtones above 4000 cycles eliminated to the unmodified sound. They were less certain when all overtones above 3000 cycles were eliminated. In most cases, the unmodified sound appeared to be preferable to the sound with all overtones above 2000 cycles eliminated. In this case, the sound appeared to lose a characteristic which might be described as "directive" or "purposive." In passing, it is interesting to note that the levels of sounds produced by the four horns cited above fall within the range that appeared adequate to override noise.

Summary

The tests that have been made suggest the following characteristics for satisfactory automobile horns for use in the metropolitan area:

1. Level of the emitted sound at the reference distance of 23 ft. should be of an order of 88 to 93 decibels. Levels in excess of this are unnecessary and objectionable. Levels less than this are insufficient to override the noise due to heavy street traffic.

2. Fundamental frequencies between 200 and 300 cycles appear satisfactory. The overtones should be harmonics of the fundamentals. The energy should preferably be distributed approximately uniformly in frequency, with just enough energy in the higher frequency ranges to secure directive properties. A relatively large amount of energy in the higher frequency ranges causes the sound to have a sharp and disagreeable character. The presence of inharmonic frequencies in the sound waves causes the sounds to have a raucous character.

Several other factors which bear on the desirability of horns, such as the suddenness with which the sound from a horn builds up to its maximum value, the use of more complicated horns to emit sounds of different character for different signalling purposes, etc., have not been touched on here. An extensive discussion of horn characteristics or an exhaustive study of the merits of any particular horn would be beyond the scope of this report. Its principal purpose has been to discuss the results of certain tests with the hope that they might suggest ways of making automobile horns less objectionable than present day horns.

JOHN C. STEINBERG

Noiseless Progress

PROFESSOR ALBIN H. BEYER—*Chairman*
Committee on Building Code and Construction
MR. CHARLES C. BURLINGHAM
MR. LAWSON PURDY

THE NOISE ABATEMENT COMMISSION desires specific recommendations from this subcommittee as to steps to be taken to reduce or eliminate noises in the city streets and buildings—especially as to changes in the Building Code permitting operations or use of materials bringing about reduction of noise within buildings or during building operations, or, if necessary, new laws and ordinances enforcing less noisy building operations.

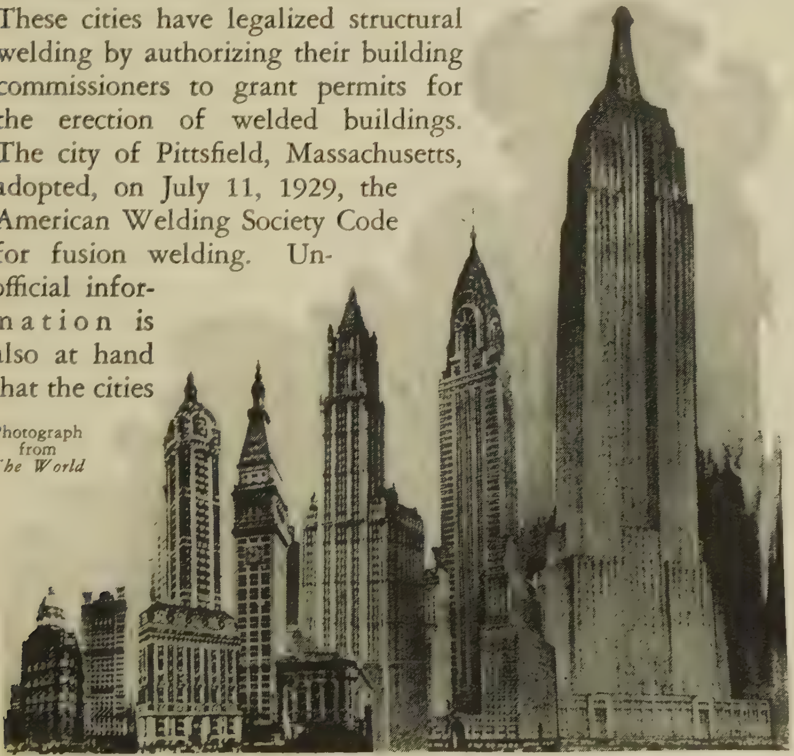
An analysis of the noise complaints received in answer to the questionnaire sent out by the Noise Abatement Commission and tabulated to date indicates that approximately 7½ per cent of all of the complaints relate to noises incidental to building and other construction activities. Of the total complaints thus received, approximately 3½ per cent are directed against the noise resulting from riveting the joints in a steel frame building by means of pneumatic hammers. This noise is especially objectionable as the steel frame of the building acts as a resonator.

Pneumatic Riveting and Fusion Welding in Building Construction

Outside of shops, where comparatively noiseless pressure riveting can be used, no practical method of driving rivets other than by means of pneumatic hammers has been developed to date.

Another method for securely joining steel members together, and one which our limited experience to date indicates to be practical, is fusion welding—a method which fortunately can be carried out without creating appreciable noise. A large amount of experimental work has been done along the lines of welding structural steel by the Westinghouse Electric Manufacturing Company, the General Electric Company, and many others. Lately, this experimentation has been carried out on a large scale, and some fifty industrial and office buildings, department stores, apartment houses, additions to hotels, and one or two bridges have been erected in which welding has been resorted to entirely or in part. The largest of these now under way is a twelve-story office building of the Southern California Electric Company at Los Angeles which will be from 75 to 80 per cent welded. Another building in which it is intended to use welding extensively is the proposed fifteen-story office building for the Boston Edison Company.

The only cities in the United States which have thus far recognized arc welding of structural steel in their building codes are 64 cities in the Pacific coast section. These cities have legalized structural welding by authorizing their building commissioners to grant permits for the erection of welded buildings. The city of Pittsfield, Massachusetts, adopted, on July 11, 1929, the American Welding Society Code for fusion welding. Unofficial information is also at hand that the cities


Photograph from *The World*

The increase in high buildings in New York City spells a corresponding increase in construction noises of Lynn, Massachusetts, and Milwaukee, Wisconsin, are considering the adoption of the American Welding Society Code.

In the foreword to the report of the subcommittee on Minimum Loads and Structural Steel and Iron of the committee on Building Laws and Regulations of the Merchants' Association of New York, the committee refers to the present status of welding as follows:

> "Welding has been developed to a high degree in the shop fabrication of many items, much more so than for structural steel. It is gradually, however, being extended into that field and must soon take its place as supplementing the present widespread use of riveting, wherever its characteristics make it the logical method. At the present moment, however, its use must be surrounded by certain well recognized safeguards to prevent incompetent and irresponsible individuals from attempting a more widespread use of the method than the available supply of competent designers, workmen and inspectors justify. The recommendations of the American Welding Society have been incorporated in our draft."

They state further:

> "In the interest of economy and to help in the reduction of noise, your Committee (Merchants' Association Committee) has judged it advisable to permit bolting of structures of medium height, when no wind stresses are involved. There is considerable experience and precedent to justify such procedure, and it is felt that this is a very desirable provision."

This committee's report includes the following clauses designed to legalize welding in New York City and permit under certain special conditions the use of bolting in place of riveting—two provisions which will go a long way toward ultimately eliminating the objectionable noise resulting from riveting:

> "*Welding.* Fusion welding may be substituted for, or used in combination with, riveting or bolting to connect or assemble the component parts of steel beams, girders, lintels, trusses, columns, and other structural steel used in building construction if done under rigid inspection and specifications, in accordance with the rules of the Board."

> "*Field Riveted, Bolted and Welded Connections.* In all tier structures less than 125 feet in height, in which the height is less than 2½ times the minimum horizontal dimension, all column splices and field connections may be bolted. . . . .

> "In all structures over 125 feet in height and in structures of a special character, connections of beams and girders to columns, and all connections of beams and girders within 3 feet of columns shall be riveted or welded. Column splices in structures 200 feet or more in height shall be riveted or welded. Column splices in tier structures less than 200 feet in height may be bolted. All other connections may be bolted, except that, in all structures, the supports for running machinery or other moving loads, shall be riveted or welded."

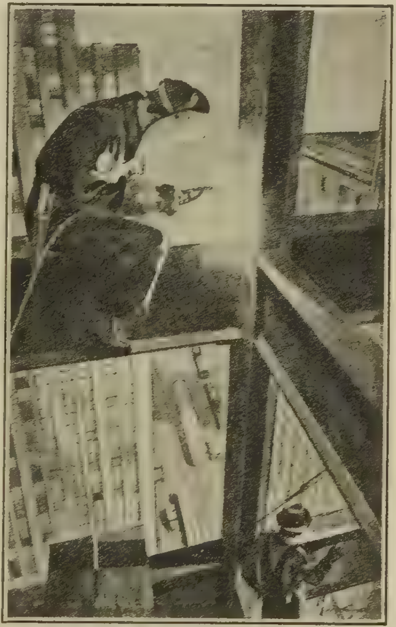
We concur in the recommendations of the Building Code Committee of the Merchants' Association of the City of New York as this offers a practical solution of one phase of this perplexing noise problem. If these recommendations are ultimately carried out the noise caused by riveting will be greatly reduced.

We recommended that the Sanitary Code be amended to limit riveting in residential districts to daylight hours. The proposed amendment as prepared by the committee on Practical Remedies is as follows:

Chap. 20, Art. 12, Sec. 229-b:
"In residential districts between the hours of 5 P. M. and 8 A. M. no person shall operate in building operations, including construction, alteration, demolition and excavation, any machinery which, by its noise, shall disturb or annoy any person in the vicinity thereof."

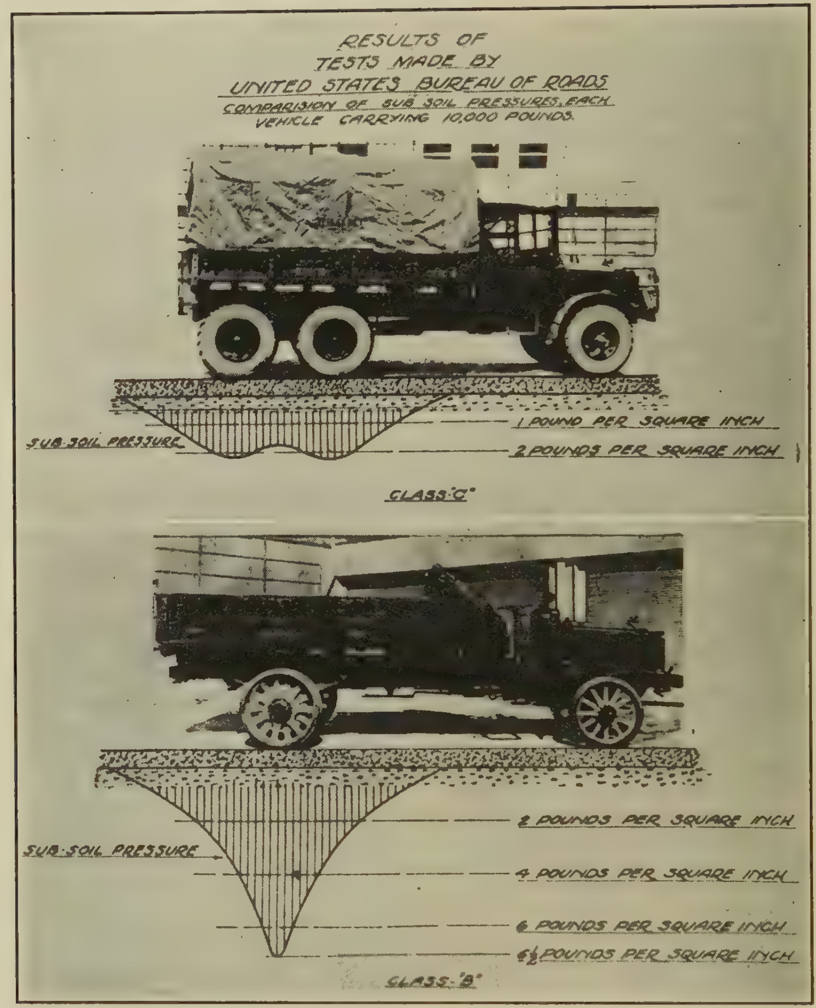
Construction Work

About 5 per cent of the complaints received relate to noises incidental to cellar, street, and subway excavations, and building foundations. These noises result largely from the use of steam and gasoline excavating shovels, rock drills, pneumatic and steam hammers, transportation, and hoisting machinery.



Drawing loaned by Westinghouse Elec. & Mfg. Co.

Arc-welding


RESULTS OF
TESTS MADE BY
UNITED STATES BUREAU OF ROADS
COMPARISION OF SUB SOIL PRESSURES, EACH
VEHICLE CARRYING 10,000 POUNDS.
1 POUND PER SQUARE INCH
SUB-SOIL PRESSURE
2 POUNDS PER SQUARE INCH
CLASS "C"
2 POUNDS PER SQUARE INCH
SUB-SOIL PRESSURE
4 POUNDS PER SQUARE INCH
6 POUNDS PER SQUARE INCH
6½ POUNDS PER SQUARE INCH
CLASS "B"

From *The Quartermaster's Review*

Sub-soil pressure gives an indication of the amount of noise a truck produces. An idea of the difference between the amount of noise produced by a truck whose load is distributed on six wheels and one whose load is carried by four wheels can be gained from this picture

So far as we have been able to ascertain, no provisions have ever been incorporated in any municipal building code in the United States to restrict or regulate the use of machinery employed in the construction of buildings and other structures within the confines of a municipality. Only in so far as these appliances affect the structural safety of the building or of adjoining property have provisions been made in a building code to limit or control the use of these appliances.

The attention of manufacturers and users of contractors' appliances and machinery used in the demolition of and construction of buildings and the construction of subways, sewers, and streets, should be forcibly directed to the fact that when such equipment is to be used within the confines of a municipality the use and operation of such machines should be made as noiseless as practical. The fact seems to be that in general noisy contractors' equipment, especially trucks, is preferred as it is usually assumed that the resultant noise is an indication of power and activity.

Nothing can be accomplished by simply calling attention to this situation. The most practical remedy is not to permit within the confines of the city after 5 P.M. and before 8 A.M. any construction activity in which unnecessarily noisy equipment is used in case quieter standard equipment is available. Under no condition should internal combustion and steam or compressed air engines be permitted to operate without mufflers or silencers attached to the exhaust. Adequate mufflers or silencers should also be required on the intakes of all air compressors.

The committee on Practical Remedies has prepared at our request a proposed amendment to the Sanitary Code to this end. The proposed amendment is as follows:

> Chap. 20, Art. 12, Sec. 229-a:
>
> "No person shall operate or cause to be operated any internal combustion engine, air compressor or steam engine, unless the same is equipped with a muffler or silencer which will prevent loud or explosive noises."

Elevated and Subway Noises

In the design and construction of the existing subways and elevated lines within the City of New York, it appears to the committee that little attention has been given to the reduction of noise resulting from their operation. From an engineering standpoint it is entirely feasible even now greatly to reduce the noises resulting from their operation, but the cost would be so great as to be absolutely prohibitive.

In connection with the design and construction of new subways and elevated lines, the committee recommends that the Board of Transportation study and investigate all available methods of construction and types of equipment which have been designed to reduce the noises incidental to subway and elevated operation so that the measures for the elimination of noise found practical can at a relatively low cost be incorporated in future subways.

It is, however, reasonable to demand of the operators of existing subways and elevated lines that all existing rolling stock, switches, rails, and rail joints be kept in the best possible operating condition and repair, so as to bring about an appreciable reduction in the amount of noise arising from this source. The committee further recommends that the noisy turnstiles in the subways be modified immediately so as to reduce the noise therefrom. The turnstile noises are as irritating to the average human being as they are unnecessary.

Street Car Noises

Various types of wheels and sound absorbing aprons have been used and tested out in other cities, both in the United States and in Europe, in order to reduce the noise resulting from the operation of the ordinary street car.

No one can predict the future useful life of our surface street car systems. It would, therefore, be unfair to compel them to make extensive and costly changes. The immediate demand, however, should be made that they keep their tracks and rolling stock in as fair a condition as possible so as to eliminate most of the noises produced by defective track and equipment.

A number of complaints have been received by the Commission on the new type of bell or gong which has recently been installed on the roofs of some of the trolley cars and which appears to be exceedingly annoying to the home owners along surface lines where these gongs are used.

We recommend that the Transit Commission be requested to investigate all cases of exceedingly loud bells or gongs on street cars and that their use be eliminated if the type in question is found to be unnecessarily loud.

More Sound Proof Buildings Are Desirable

In conclusion we wish to state that it is not possible to eliminate or to even reduce materially many of the noises arising from the normal activities of a busy city. The best that can be hoped for is the elimination of, or the material reduction in the thousands of noises which are as annoying as they are unnecessary and consequently have an unusually disturbing effect upon the human mind.

For adequate protection from the normal city noises the home owner and worker within the city must continue to look toward improvement in building construction, that is, to the more general use of materials and forms of construction which, both by the reduction of the transmission of sound or by the absorption of sound, will render his home or his place of business a better place in which to live and work.

Report On Methods of Quieting Subways and Elevated Railroads

Statement Prepared for the Board of Transportation by Chief Engineer Robert Ridgway and Submitted to the Noise Abatement Commission by John H. Delaney, Chairman of the Board

THE question of noise prevention on rapid transit lines has been a matter of concern to this Board and its engineering department for a number of years. Investigation has been made of the matter and it is believed that substantial progress has been made by incorporating various features in the new independent system of subways, which it is expected will reduce the noise of operation.

Changes in Car Design

A number of experiments have been made in different parts of the country, mostly on trolley cars, looking to the reduction of noise. These experiments have been carefully studied. However, of the many schemes proposed or tried there were comparatively few which could consistently be incorporated in the designs of the new cars without first trying them out experimentally in the subway. This could not be done on the cars of the new line until after operation was begun and the operating companies of the existing lines were not sufficiently interested to do this work on their lines. It has, therefore, been necessary to defer the consideration of schemes for noise reduction which are of an experimental nature until our new line is placed in operation.

One suggestion was to bolt pads of rubber or other material on the wheels to take the ring out of the wheel. This had a quieting effect on trolley cars where it was tried and might be expected to produce the same result in the subway, but of the several details proposed to do this, all were objectionable for our heavy subway service.

Another detail which seemed to eliminate some of the noise was the construction of a vertical skirt carrying sound absorbing material around the contour of the lower car frame. This was proposed so as to keep down the amount of noise that reached the outside and thereby reduce the amount of noise to be reflected from adjacent structures.

There were other similar ideas which, however, it was found necessary to leave for later experiment.

Certain improvements have been made, however, along this line:

1st: A truck has been designed from which it is believed there will be less noise due to loose and rattling parts. It is expected that a considerable part of the noise of operation will be eliminated by this change in design.

2nd: There has been developed a plan for practically eliminating the ring of the gears. This will not eliminate all of the gear noises but it is believed that it will cause a substantial reduction from that of the present type of gearing. This improvement in noise conditions is accomplished by attaching a cast-iron ring inside the rim of the gear on each side. Due to the difference in character of their structures this is expected to eliminate the resonant effect of the gear proper. The normal gear struck with a hammer rings like a bell, whereas the gear modified as above, struck in the same manner, is free from the bell effect.

3rd: The resonance of the car body has been reduced by applying felt insulation on the inside of all side sheets of the car bodies. This construction was used on the B. M. T. cars and they are noticeably less noisy than the I. R. T. cars, and it is expected that the cars of the new system will be similarly improved by this construction.

Noise Deadening at the Tracks

The rails for the new subway structures are being laid practically end to end instead of having a small distance, ¼″ or ⅜″, at the joints in order to reduce noise caused by the wheels passing over such joints. Furthermore, the track is being laid on ties imbedded in concrete. This will permit of more accurate line and grade, hence smoother running track. On ballasted track such as now exists in the subway, considerable noise is due to the low rail joints as it is not possible to keep the ties on perfect grade when laid in loose ballast. The welding of rails at the joints has been discussed but on account of the possible injury to rails from the high heat generated during the welding progress and on account of difficulties in connection with the maintenance of a continuous rail, welding has not been adopted.

Elevated Railroad Structures

Studies are being made for reducing the noise by reason of operating rapid transit trains on elevated structures. An experiment is to be tried of placing some type of rubber pad between the ties and the rails or between the ties and the steel of the elevated structure. The rubber companies consider it feasible to produce a substantial rubber pad which can stand the heavy train loading and keep in good condition for some eight or ten years.

Consideration is also being given to the question of covering the elevated structure in some manner with material that will deaden and absorb the sound vibrations and prevent the girders acting as sounding boards.

Subway Structures

The question of placing sound absorbing material on the walls and ceilings of the subway is also under consideration. It has been difficult, thus far, to find a material that will absorb the noise and at the same time offer sanitary conditions that would be proper for use in the subway. The surface of the concrete and tile now forming the walls and ceilings of the subway is hard and sound reflecting so that the noise that is generated in operation is probably reechoed many times causing intensification of the original noise caused by the operation of trains.

The Board and its engineers in their studies of this question realize the importance of the problem, not only on account of the effect of the noise on property adjoining elevated structures, but also particularly, in the case of subway operation, the serious effects on the nervous system of the riders in the subway trains, and it is endeavoring by every possible means to effect a substantial reduction in noise in subway and elevated transit operation.

Practical Remedies

CHARLES C. BURLINGHAM, *Chairman*
Committee on Practical Remedies

SAMUEL A. BROWN, M.D.
ALFRED H. SWAYNE
EDWARD F. BROWN

THE Committee on Practical Application of Remedies has had the cooperation of the Police Commissioner, the Corporation Counsel, and other public officials in the study of existing legislation and in the preparation of new ordinances.

We have prepared three amendments to the law:

(1) An amendment to Article 12—Chapter 23 of the Sanitary Code as follows:

> [1]Sec. 230-a. "Noise from Radios, etc., Prohibited. No person owning, occupying or having charge of any building or premises, or part thereof, shall keep or allow thereon or therein any radio, phonograph or other sound making or reproducing device which shall by noise disturb the quiet or repose of or shall annoy any person therein or in the vicinity."

Under the present law such disturbing noises are a public nuisance which can be abated only by court proceedings, at which it must be shown that a considerable number of people are disturbed and annoyed. The amendment makes such noises a clear violation of law which can be punished like other violations of the Sanitary Code and the Ordinances without the necessity of proving a public nuisance.

(2) An amendment to the Code of Ordinances, as follows:

> [2]Section 137. "No person shall use or operate, or cause to be used or operated, in front or outside of any commercial establishment, nor in any window, doorway or opening of such establishment, abutting on or adjacent to a public street or place, any device or apparatus for the amplification of sounds from any radio, phonograph, or other sound-making or sound-reproducing device without a permit from the police commissioner therefor nor in any case within two hundred and fifty feet of a school, court house or church during the hours of school, court or worship, nor within two hundred and fifty feet of any hospital or similar institution."

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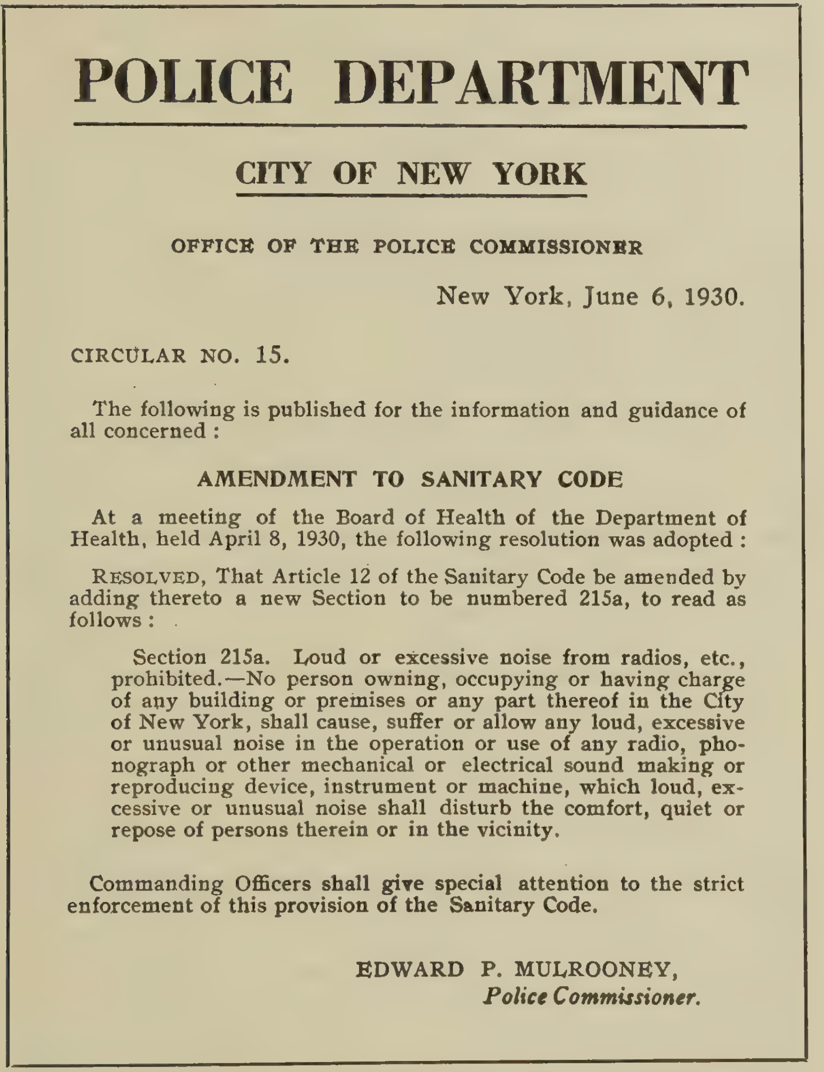
1. See page 207, Section 215-a, adopted by Board of Health, April 8, 1930.
2. See page 207, Section 137, adopted by the Board of Aldermen, May 20, 1930.



POLICE DEPARTMENT

CITY OF NEW YORK

OFFICE OF THE POLICE COMMISSIONER

New York, June 6, 1930.

CIRCULAR NO. 15.

The following is published for the information and guidance of all concerned :

AMENDMENT TO SANITARY CODE

At a meeting of the Board of Health of the Department of Health, held April 8, 1930, the following resolution was adopted :

RESOLVED, That Article 12 of the Sanitary Code be amended by adding thereto a new Section to be numbered 215a, to read as follows :

> Section 215a. Loud or excessive noise from radios, etc., prohibited.—No person owning, occupying or having charge of any building or premises or any part thereof in the City of New York, shall cause, suffer or allow any loud, excessive or unusual noise in the operation or use of any radio, phonograph or other mechanical or electrical sound making or reproducing device, instrument or machine, which loud, excessive or unusual noise shall disturb the comfort, quiet or repose of persons therein or in the vicinity.

Commanding Officers shall give special attention to the strict enforcement of this provision of the Sanitary Code.

EDWARD P. MULROONEY,
Police Commissioner.

The Police Department has given alert help in the abatement of radio noises.

This amendment would put a stop to the offensive noises produced by loudspeakers in the public streets and places, but would permit, for reasonable and legitimate purposes, public announcements by loudspeakers in places where citizens would not be disturbed. This amendment has been introduced in the Board of Aldermen by Alderman Murray W. Stand.

(3) An amendment to the Greater New York Charter:

> Section 113. In the case of minor offenses constituting violations of the Code of Ordinances, including the Sanitary Code and Park Ordinances, and not involving serious danger to health, morals, safety or public welfare, the head of any administrative department the administration of which is concerned with any such violations is hereby authorized and empowered to prepare and promulgate a schedule of such offenses with fixed fines or penalties applicable thereto not to exceed five dollars for each such offense to be paid by offenders who confess violation of the same and who do not desire a judicial hearing. Said department heads are further authorized and empowered to make uniform rules regulating the giving of notice of such violations by department representatives. Any notice or violation hereunder shall be returnable at the office of the Chamberlain of the City of New York who shall make proper provision for the receiving of payment of such fines (in the several boroughs) and the giving of proper receipts therefor. Each department on the service of any such notice shall immediately notify the said Chamberlain thereof, and in case any violator shall fail to pay such fine within the time specified therefor the Chamberlain shall inform the department issuing such notice, which shall thereupon cause a summons to be served on said violator. Nothing in this section contained shall prevent the police or representative of any department from sending a summons in a proper case or making an arrest as provided by law.

This amendment is a far-reaching one, covering not only noises, but many minor offenses which constitute violations of the Sanitary Code, Park Ordinances, and other police regulations. It introduces a novel system for New York City, a system, however, which is in successful operation in European cities as well as in some of our own. In effect, it is merely an extension to other minor violations of the system now employed before the Commissioner of Licenses and also for certain violations of the Sanitary Code, where the Commissioner is empowered to hear and determine complaints and impose small fines. Various administrative fines in the federal government have been squarely upheld and approved by the Supreme Court of the United States as constitutional. (*Oceanic Steam Navigation Co. v. Stranahan* 214 U. S. 320. *Hampton & Company v. United States* 276 U. S.

394.) A somewhat similar fine imposed and collected by the Police Department on cars parked in the streets in the theatre district has recently been passed on and approved in the state courts.

The advantage[1] of such a law would be the relief from the annoyance of court proceedings in the vast majority of cases which make it necessary for policemen to leave their regular duties to attend court. The present heavy penalties tend to make the law ridiculous; it is inconceivable, for example, that any magistrate would punish a man for spitting in the elevated or subway trains by a fine of $500 or imprisonment for one year, which is authorized under present law. The proposed section carefully safeguards the rights of those who are unwilling to admit their fault and wish a hearing before a magistrate.

This amendment, worked out by this committee with the cooperation of Chief Magistrate J. E. Corrigan and Judge W. Bruce Cobb, has the endorsement of the heads of departments whose work would be facilitated by it: Police Commissioner Mulrooney; Dr. William Schroeder, Jr., Chairman of the Sanitary Commission; Deputy Manhattan Park Commissioner John M. Hart; Dr. Shirley W. Wynne, Commissioner of Health. In this form it has been referred to the Drafting Commissioner of the Municipal Assembly.

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[1] a. The police officer or inspector of the Sanitary Department or Park Department will not be compelled to go to court and waste time there when he might be performing useful duties on his regular round. At present probably a thousand policemen are in the courts every day attending on the return of summonses served on offendng citizens. Much of this could be done away with by a simple system of small fines collected by administrative officers.

b. It will materially increase the ability of the present law officials to handle minor violations of this nature by enabling them to penalize many violations now passed over because of the time and trouble involved in following them through the courts.

c. There will be no handling of any money or any discretion exercised as to the amount of fine by the police or similar officials in the Park Department or Sanitary Commission. All collections of these fixed fines will be in the office of the City Chamberlain and the amount of the uniform fine published and known.

d. The payment of fines can be rapidly and systematically handled by a single official in each borough, but the amount of the fine and trouble of going in person to pay it on pain of receiving a court summons if not complied with will be a substantial deterrent against repetition.

e. The magistrates' courts will be relieved of the burden of handling the great number of cases of minor violations under these provisions which come before them and in which there is no dispute that the offense has been committed.

f. The magistrates will have more time to devote to important violations and violations in which there is a dispute of fact.

g. The rights of the citizen to a judicial hearing will be at all times protected, as he will be always permitted to refuse such a notice and accept the usual summons to a magistrate's court.

h. The excessive hardship of wasting long hours in overcrowded court rooms away from their vocations will be spared citizens, both men and women.

i. The ordinary citizen will come away from the magistrate's court with a greater respect for the orderly processes of the law when these are not hurried and impeded by the present flood of cases involving minor violations about which there is no dispute.

In order to bring speedy relief to citizens who are annoyed by the use of radio loudspeakers in their homes during the late hours of the evening, we asked the radio stations in New York City to cooperate in a campaign designed to educate radio listeners in noise etiquette. The stations cooperated whole-heartedly and each night at 10:30 had announcements made requesting their listeners to remember that radios might be disturbing their neighbors and to tune them down as an act of good sportsmanship. These announcements were made for a period of from one month to six weeks and we received many letters from radio listeners informing us that the announcements had produced excellent results.

A number of complaints were received from persons who had been annoyed by the sirens and cut-outs of the mail trucks. When the postmaster was informed of these complaints he immediately offered to cooperate with the Commission by instructing all drivers to refrain from using their warning signals or their cut-outs except to avert accidents. This one act on the part of the Post Office Department brought relief to many persons living on the streets traversed by these trucks.

The noise of whistles from vessels on the rivers and harbor of New York City has been annoying to a large number of people whose homes or offices are located near these waterways. Believing that this problem should be handled by men familiar with all of the contributing sources, Dr. Wynne called a conference which was attended by representatives of the principal steamship companies, of the Tow Boat Exchange, of the federal government, and interested citizens. The problem was placed before these men and a committee was appointed to study the situation and prepare recommendations for abating unnecessary whistling by passing vessels.

In the belief that there is a large amount of unnecessary blowing of whistles which is prohibited by law we have invited and received the cooperation of the Steamboat Inspection Service, the Captain of the Port of New York, and the Supervisor of New

Quiet ahead for subways

York Harbor. These services will cooperate by reporting violations of the law to the Steamboat Inspection Service, which will investigate the complaints and hold hearings. This, we believe, will result in considerable decrease in noises from this source.

Of the many complaints directed against automobile horns a large number relate to the blowing of horns by drivers of automobiles which are parked or which are not in motion. The habit of many drivers of signalling to persons within houses in front of which they are parked is extremely irritating and we propose an amendment to the Sanitary Code which will make unlawful the generation of such noises. The proposed amendment is as follows:

> Amend Section 229 of the Sanitary Code by adding after the word "warning" in the third line of the second paragraph the following: "and no such person shall sound a horn or other signalling device while such automobile or vehicle is at rest except as a warning in the presence of imminent danger."

At the request of the committee on Building Code and Construction this committee has prepared two amendments to the Sanitary Code as follows:

> Chap. 20, Art. 12, Sec. 229-a: "No person shall operate or cause to be operated any internal combustion engine, air compressor or steam engine, unless the same is equipped with a muffler or silencer which will prevent loud or explosive noises."
>
> Chap. 20, Art. 12, Sec. 229-b: "In residential districts between the hours of 5 P. M. and 8 A. M. no person shall operate in building operations, including construction, alteration, demolition and excavation, any machinery which, by its noise, shall disturb or annoy any person in the vicinity thereof."

Digest of Provisions Regarding Noise in New York Code of Ordinances

I. *Provisions Affecting Autos and Trucks*

Mufflers on motor vehicles required. Chapter 24, Article 3, Section 36, Page 530.

Bell or gong similar to those used on ambulances prohibited. Chapter 24, Article 3, Section 19, Page 528.

Exhaust horns prohibited. Chapter 23, Article 12, Section 132A, Page 498.

Mufflers on motor vehicles required and prohibition against operating horns for an unreasonable or unnecessary time. Chapter 20, Article 12, Section 229, Page 448.

II. *Provisions Against Noise in Streets*

General provisions prohibiting unnecessary noise in streets. Chapter 23, Article 12, Section 130, Page 494.

Provisions against unnecessary noise in hospital streets. Chapter 23, Article 12, Section 131, Page 494.

Provisions against unnecessary noise in school streets. Chapter 23, Article 12, Section 132, Page 494.

Regulations of peddlers and hawkers and the hours in which they may cry their wares. Chapter 23, Article 12, Section 133, Page 495.

Regulations of junkmen's bells. Chapter 23, Article 12, Section 134, Page 495.

Regulations for the loading of iron and steel rails. Chapter 23, Article 12, Section 135, Page 495.

Regulation requiring license for street musicians or showmen to operate a drum or other instruments on the street. Chapter 23, Article 12, Section 136, Page 495.

The use of noise to attract persons to an auction prohibited. Chapter 23, Article 6, Section 30, Page 484.

III. *Miscellaneous Provisions*

Bell or gong on building regulated. Chapter 20, Article 12, Section 228, Page 448.

Maintaining a noisy bird or animal prohibited. Chapter 20, Article 12, Section 215, Page 446.

Where a nuisance is found by the Board of Health it must be abated when an order therefor is granted. Chapter 20, Article 11, Section 185, Page 442.

General provision to keep premises free from conditions prejudicial to life and health. Chapter 20, Article 10, Section 183, Page 441.

Discharge of fireworks or fire crackers without license prohibited. Chapter 10, Article 5, Section 95, Page 271.

Memorandum on Nuisance Cases

The gist of a public nuisance seems to be to commit any act which will annoy, injure or endanger the comfort, repose or health of any considerable number of persons. Any such noise alone or noise accompanied by vibration if it be of such character as to produce actual physical discomfort or annoyance to a person of ordinary sensibility may create a nuisance. This is so even though the noise results from the carrying on of a trade or business in a town or city. *People vs Hess,* 110 Misc. 76.

> "Noise alone, or noise accompanied by vibration, if it be of such character as to be productive of actual physical discomfort and annoyance to a person of ordinary sensibility, may create a nuisance, though such noise and vibration may result from the carrying on of a trade or business in a town or city. 20 Rul. Cas. Law, 445. The difference between a public nuisance and a private nuisance does not consist in any difference in the nature and character of the thing itself, and the proceeding may be criminal in form when the nuisance affects a considerable number of persons."

Proof of criminal intent is not necessary to sustain a conviction of maintaining a public nuisance. *People vs High Ground Dairy Company,* 166 App. 81.

A suit to enjoin a private nuisance will be sustained when it clearly appears that the enjoyment of life and property is materially lessened thereby and the physical comfort of persons in their homes is materially interfered with. *Russell vs Nostrand Athletic Club,* 212 App. Div. 543, where the Court said:

> "A condition is a nuisance when it clearly appears that the enjoyment of life and property is materially lessened thereby and the physical comfort of persons in their homes is materially interfered with."

See also *Andrews vs Perry,* 127 Misc. 320, where the Court said that there was no hard and fast rule as to what constituted a nuisance but it was to be decided from the particular facts and circumstances in each case. There a hot dog stand was operated in a residential district late into the night and the neighbors were disturbed by the noise, odors, and litter emanating from the stand. Injunction was granted.

Dillon vs Cortland Baking Company, 224 App. Div. 303. There an injunction was granted against the loading and operating of delivery trucks during the night or in the early morning where such caused sufficient noise to disturb people in the vicinity. The Court held that a nuisance existed if the conditions created actual physical discomfort and annoyance to a person of ordinary sensibility.

See also *Parkhurst vs Citizens Brewing Company,* 171 New York Supplement 683—conformed 229 New York 602.

New Laws Relating to Noise

Ordinance adopted by the Board of Health of the City of New York April 8, 1930:

> Amendment No. 173-1930.
>
> Section 215-a. "Loud or excessive noise from radios, etc., prohibited. No person owning, occupying or having charge of any building or premises or any part thereof in the City of New York, shall cause, suffer or allow any loud, excessive or unusual noise in the operation or use of any radio, phonograph or other mechanical or electrical sound making or reproducing device, instrument or machine, which loud, excessive or unusual noise shall disturb the comfort, quiet or repose of persons therein or in the vicinity."

Ordinance as adopted by the Board of Aldermen of the City of New York May 20, 1930:

> "Be it ordained by the Board of Aldermen of the City of New York as follows:
>
> Section 1. Article 12 of chapter 23 of the code of ordinances of the City of New York is hereby amended by the addition of a new section following section 136, to read as follows:
>
> Sec. 137. Radios, phonographs and other sound devices.
>
> No person shall use or operate, or cause to be used or operated, in front or outside of any building, place or premises, nor in or through any window, doorway or opening of such building, place or premises, abutting on or adjacent to a public street or place, any device or apparatus for the amplification of sounds from any radio, phonograph, or other sound-making or sound-reproducing device without a permit from the police commissioner therefor, nor in any case within two hundred and fifty feet of a school, court house or church during the hours of school, court or worship, respectively, nor within two hundred and fifty feet of any hospital or similar institution.
>
> Sec. 2. The table of section headings of article 12 of chapter 23 of the Code of Ordinances is hereby amended by adding the following line at the end thereof:
>
> 137. Radios, phonographs and other sound devices.
>
> Sec. 3. This ordinance shall take effect immediately."

Finances

DR. ARTHUR B. DUEL, *Chairman*
Committee on Finance

DR. FOSTER KENNEDY
DR. FREDERICK TILNEY

SO FAR the work of the Noise Abatement Commission has been made possible through the unpaid services of private individuals and of organizations and through the whole-hearted cooperation of city departments. These contributions range from personal services—given freely by the members of the Commission, itself, by the director, by individuals, and by members of the Health Department staff—to the use of laboratory facilities and the services of engineers—generously donated by large organizations. They, naturally, cannot be set down in a financial statement. The work of the Commission alone can give an estimate of their tremendous value—work that ordinarily would have taken years to accomplish done within the nine months the Commission has been in existence.

Filling a most important need in this campaign along the modern frontier of noise, generous financial contributions of individuals, foundations, associations, and organizations have made possible the carrying out of the program to the present, for which no city appropriation has been asked—and cannot be asked until the pioneer phase of the movement is past and the work established on a routine basis.

REPORT OF THE TREASURER

RECEIPTS

Contributions:

Altman Foundation	$3,000.00
Mrs. William H. Moore	500.00
A. S. Hutchins	100.00
Jeremiah Milbank	100.00
George Whitney	250.00
Mrs. and Mrs. Thomas W. Lamont	100.00

W. R. K. Taylor	100.00	
Mrs. A. J. Fox	10.00	
Bank Interest	18.40	
Total Receipts		$4,178.40
DISBURSEMENTS		
Office Supplies	$ 180.43	
Salaries and Wages	2,108.05	
Photographic Services	125.00	
Printing	1,310.09	
Miscellaneous	119.60	
Total Disbursements		3,843.17
Balance August 13, 1930		$ 335.33

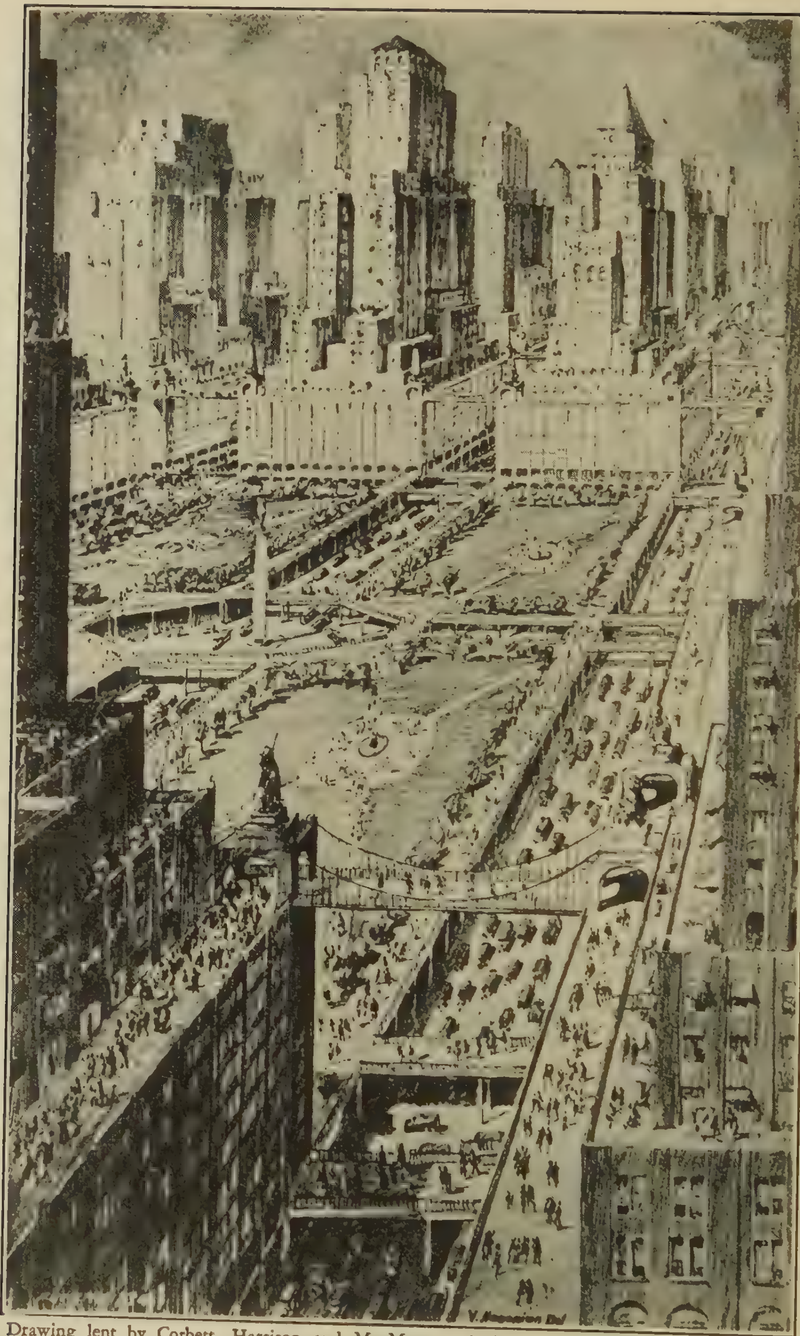
ARTHUR B. DUEL, *Chairman*
Finance Committee

EDWARD F. BROWN, *Treasurer*
505 Pearl Street
New York City

Seeing It Through

The members of the Commission have pledged themselves to see the work of noise abatement through to the time when it is established on such a healthy foundation that it will be a part of the city's work. Their first recommendation is to speed up the program through a wide educational campaign, teaching the seven million inhabitants of our city to avoid unnecessary noise, and through the continuation of our cooperative and provocative work with industrial corporations and, particularly, with manufacturers of widely used devices to abate noise at the source.

To carry on this campaign for the next year requires at least $50,000. We are now asking New Yorkers to contribute this sum. It is fitting and proper that the contributions be on a democratic basis—as many citizens as possible sharing in this civic enterprise.



Drawing lent by Corbett, Harrison and MacMurray, Architects

The new architecture gives relief from noise in the stories just above the set-backs.

Radio Talks

So popular has been the response of the public to these radio talks that the Commission has inserted them in this report as a suggestion to other cities that plan to wage a campaign against noise.

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Noise as a Health Problem[1]

IN the last thirty years most of us have seen—or rather heard—the greatest increase in noise the world has ever known. And most of us have felt a sort of pride in it, knowing that it spelled increase in industry, in building—in prosperity. Back in the first decade of this century, when this great development of noise was just beginning, O. Henry sang praises of the hum of the "L" and the clang and clatter of city streets. Even in his last pathetic lines, "Adventures of Neurasthenia," he expressed his love of city noise and complained of the quiet of the country where his friends had invited him in the hope that he would recover his health. He said he could not sleep without the comforting lullaby of noise; he complained of the silence of the country so deep that he could "hear the grass blades sharpening themselves against each other."

But noise is not a lullaby—and never has been. It was the chief danger warning for primitive man—and for people during all the ages up to our own strident present. The more discordant the noise, the more menacing the danger as a rule!

Today we hear hundreds of noises a day that would have struck terror to the hearts of our ancestors. And they strike terror to our hearts too—almost literally—whether we are conscious of it or not.

Why We Respond to Noise

Experiments have shown that when we hear a loud noise—especially one that is intermittent like the screeching of automobile brakes now and again throughout the day—our heart action becomes more irregular, our muscles tense for action, our movements more energetic. In brief, we are undergoing the fear reaction—we are keyed up to fight whatever strange new danger these sounds may betoken, just as the cave-dweller was keyed up to fight when he heard the roar of wild beasts or just as the lone homesteader was steeled to heroic action by the war cry of attacking Indians. This fear reaction is a sort of emergency measure enabling the body to put forth extra effort in a crisis—extra effort at a cost!

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[1] Address by Shirley W. Wynne, M. D., Dr. P. H., Commissioner of Health, City of New York, before the Civitas Club, December 11, 1929.

So deep-seated is this reaction to noise—even new-born babies have it upon being exposed to loud noise—so deep-seated, scientists tell us that we never do completely overcome it. True, as we grow older, we can discipline ourselves to a certain extent and we do. But the fact remains that our unconscious reaction to noise continues in spite of our conscious indifference to it.

The effects of this fear reaction and the attention-scattering effect produced by noise are so closely interwoven in our actions that I shall make no attempt to differentiate between them in the following instances.

Twenty years ago Muensterberg found a woman working in a printing shop where she was exposed to the constant noise of trucking in a passageway. It is likely that she was barely conscious of the daily noise, but, upon being removed to a spot less exposed to such noise, her work was increased twenty-five per cent in quantity.

In a European factory, experienced workers made 60 mistakes in assembling 80 temperature regulators. They were working next to a boiler shop with its proverbial din. When they were removed to a quiet place they assembled 110 temperature regulators in the same length of time as they had formerly taken to assemble 80 and they made only seven mistakes.

In recent experiments with office workers, a 50 per cent reduction in noise brought a five per cent increase in the production of typists—the best typists responding most favorably to decreased noise.

Noise Interferes With School Programs

Teachers and principals of schools are constantly writing me of the delay noise causes in their daily program—a delay which mounts high in the sum of the year's work. In fact, I hope to see this phase of the subject studied thoroughly so we may give the school children of our city the benefit of adequate noise abatement. I should not be surprised to find that a certain habitual lack of attention, a certain jerkiness of thinking comes from studying and reciting in an atmosphere of noise. This condition certainly is not aided when children come home and are forced to do their home study in the midst of the confusion and din that prevails in many households.

Noise and Accidents

While we are on the subject of children let me speak of another evil consequence of noise. I believe that the confusion and distraction of noise have a lot to do with street accidents Last year 325 children under sixteen were killed in New York City and over 13,026 injured by motor vehicles; 5,540 were killed in the entire country. I truly believe that if these children could only tell of their mental state at the time of the accident an appallingly large number would say they were confused by the multitude of sounds. Especially is this likely to be true in large cities, where added to the traffic maze and the tendency to toot the horns on every pretext there is the tricky reverbration of sound around corners and the false echoing produced by buildings.

Children have a quarrel with noise on another score—that of disturbing their sleep. Daily I get letters from men and women protesting against night noise of one kind or another, but the only protest I have ever received from a child came from the five-year old daughter of some friends of mine the other evening. When I arrived for dinner she was brought in to greet me before her nurse bundled her off to bed. I took the youngster on my lap and we visited for a little while until she nestled right down and went to sleep in my arms. So I carried her into her room and laid her on her bed. At that instant the neighbors across the courtyard turned on their radio full blast and someone burst out laughing. The child tossed a couple of times and then sat upright. "Always, always, they're making noises over there," she said indignantly. The nurse hastened to put down the windows and explained to me, "Sometimes we have to keep these windows down until after midnight." Such a remedy, as bad as, if not worse than the noise, should not be necessary, but at present what is a poor distracted mother going to do?

I realized that a large number of parents are hard put to it to find quiet sleeping rooms for their children. Rooms on a courtyard are exposed to such noises as I have just mentioned; rooms on the street are exposed to traffic noises. Other parents are downright inconsiderate of their children's rights. They send their children to bed early and expect them to sleep while they, themselves, are entertaining their friends. There is usually a good deal of noise, music, laughter and conversation, that cannot help but penetrate into the children's rooms. This could be avoided I am sure, by the use of sound absorbing material both in the children's rooms and dividing their rooms from the rest of the house.

What shall we do about the children whose parents do not care—the children whose parents cannot afford to take precautions for their children's well-being—and the children whose parents are too ignorant to know?

I venture to say that in crowded sections of our city are children who never know a moment when their ears are not bombarded by noise. In the light of what has been discovered about noise and the fear reaction, it would seem that these children must be constantly keyed to fighting pitch. This seems especially significant to me when I consider the increase of the gangster type in the last twenty years. As far as I know, no study has ever been made along these lines. But, if we only could make a study of this phase of the question—and in time we shall—I am confident the facts would be very revealing.

The Intuition of People Has Scientific Value

At present, the intuition of most people that noise is harmful has a certain scientific value. It points the way to investigation by scientists both as to what noises really cause trouble and as to methods of abating them.

The Noise Abatement Commission started off by seeking complaints from all quarters of Greater New York. Filled-out questionnaires published by request in a number of metropolitan newspapers have been pouring into the Health Department Building for the past three weeks. And everyone of these question-

The coming of high buildings brings more people, more traffic, and more noise; and the high walls reflect this noise back and forth.

naires is helpful in rounding out the picture of New York noises that need investigation.

You may not think it means much whether Mrs. Richard Roe in the Bronx or Mr. John Doe in Brooklyn or Miss X. of Manhattan or Mrs. Smith of Queens or Mr. Jones of Staten Island filled out that questionnaire and sent it in, but the truth is the information they gave could have been obtained in no other way. That loudspeakers in front of shops on middle Broadway make a certain man dizzy; that heavy trucking disturbs dwellers on Riverside Drive, on Tenth Street, on Eastern Parkway—to mention a few of the places; that "the people upstairs" in many parts of town seem always to be staging gay parties with much music, dancing, and laughter; that youths and maidens grouped on front stoops sing in close harmony at unreasonable hours of the night; that brakes squeak; that horns toot; that street cars rumble; that ash cans clatter; that exhaust cut-outs roar; that traffic whistles set folks' nerves on edge—all this makes a clear sketch of what and where and when the noise of New York exists. Thousands of New Yorkers answered this questionnaire—enough to make this composite sketch a real help to the Commission, for the number of answers was so large that it was possible to study the relative frequency of the various causes of complaint.

New Yorkers' Civic Responsibility

More than that it shows a spirit of civic responsibility on the part of individual New Yorkers that would certainly astonish a critical outsider ignorant of how truly close to the problems of the city the real New Yorker is. Of course, in the case of noise no New Yorker can ever be very far away from it; noise pervades the city and undoubtedly does increase the nervous tension of our daily life.

Even without the complication of city noise our lives are tense enough. In the course of a year every city man and woman has as many problems to meet—as many crises to avert as our ancestors had in the course of their lifetimes. We are forced to speed up our mental and emotional lives to live in this modern world where time and space are practically eliminated. It is a strain on all the human adaptability we can muster. I am confident that we can live these lives of ours more efficiently if we do away with the unnecessary noises that surround us.

In London—where noise has never reached the degree it has here—they have been thinking seriously about the problem, especially the medical men who know the effects of noise upon their patients. Just about a year ago a deputation from the Medical and Science Councils of the People's League of Health waited on the Minister of Health and explained the grave need for noise abatement. In this deputation were men eminent in the fields of neurology, psychiatry, and medicine.

Professor George Robertson, M. D., said at that time, "The effect of noise, especially prolonged noise, on the nervous system may be in the nature of a constant strain and drain on nervous energy and this may lead ultimately to exhaustion. It is this action of noise, causing nervous and mental exhaustion, that leads to neurasthenia. This seems to be a much more common disease now than formerly. It is alleged that loss of sleep occurs either as cause or a symptom of mental breakdown in about 75 per cent of the cases. . . . Undoubtedly loss of sleep is one of the causes of insanity—and the production of sleep one of the means by which insanity is prevented and also cured."

Noise Robs City Dwellers of Sleep

"The ordinary worker, if he is to support himself and his family," said Sir Robert Armstrong-Jones from his medical and scientific experience, "if he is to carry on, has a pre-arranged and proper setting for his period of rest, and his life is of necessity one of routine. He goes to bed tired and exhausted, but he is repeatedly roused and his sleep disturbed by loud and most distressing noises. He rises in the morning, shaky, confused, and unrefreshed after his so-called 'night's rest.' His health suffers, his work deteriorates. . . .in any case unless he can secure natural sleep his health is ruined. Men and women are not the only sufferers. The general health of children becomes affected from loss of sleep. Their development is impeded and their growth is retarded from this cause which is preventable. As a consequence they become inattentive mentally, they show restlessness and the question of the lack of proper sleep for children has been specially referred to this year in the Report of the Medical Officer to the London County Council."

"Everyone recognizes the difference in mentality between children reared in quiet, peaceful surroundings and those who through force of circumstances, are brought up midst the roar and din of traffic," Dr. Mathew B. Ray said to the Minister of Health. "The perpetual over-stimulation of the auditory nerves, and through them the higher centres of the brain by these discordant sounds, has a most deleterious effect on the power of concentration and eventually produces varying degrees of mental irritability and instability."

I could not help coin a word as I read Dr. Ray's statement—a word describing a certain kind of mind we come in contact with every day, in every line of work. The word is "jazz-minded." How often do you find people who can think on a subject only long enough to speak a sentence or two and then must leap on to the next subject—helter-skelter like the motifs in a jazz medley.

Berlin Physicians' Case Against Noise

In Berlin—that city that once was the example of the whole world for stately quiet—they have found themselves in these post-war years overwhelmed by modern noises not named in the old ordinances. The Berlin Chamber of Physicians has taken up this subject and after due study recommends that harmonious auto horns be used and that they be used sparingly both as to duration of sound and number of times tooted; that muffling devices be adequate and in constant repair; that motorcycles be especially constructed to avoid noise; that residence districts be thoroughly protected against traffic noise and in particular against night noise; that hospitals, sanitariums, and health resorts shall be guarded from encroaching noise; that health resorts shall do away with noise that interferes with the healing recreative nature of the place; that noise-making workshops shall not be allowed to establish themselves in vacant apartments and private dwellings; that loudspeakers shall be used only at such times and under such conditions as tenants agree upon with their landlords—all this subject to police control. This is the program planned by medical men who have been roused by the modern noise in their once quiet city.

And what about our own city? The Noise Abatement Commission, made up of men eminent in the fields of medicine, neurology, psychiatry, human relations, engineering, building, law, and the automotive industries are giving of their time and of their thought to make a good shipeshape job of quieting our city's noises.

Their work is now going on. They are testing those noises and those neighborhoods complained of in that first questionnaire.

In the meantime, there are noises that our common sense tells us are quite unnecessary. Why not do all we can to avoid them? Why not develop a new etiquette—a new and more civilized behavior to overcome these noises?

If we could only bring things to the stage where a maker of unnecessary noise is as uncomfortable over his mistake as the man in the advertisements who used the wrong fork—then we will be a better, quieter city.

I am no Mrs. Emily Price Post, myself, but as a seasoned citizen of New York I recommend the following rules of etiquette:

For Automobilists

1. Look to the brakes on your car—squeaking brakes cause a large share of the complaints received during the year.

2. Don't toot the horn unnecessarily. Tooting to attract the attention of your friends in the house is lazy and selfish. Tooting during traffic waits accomplishes nothing but increases the nervous tension of those waiting in line and irritates everyone within earshot.

3. Is the muffler loose on your car? The accumulated sound caused by loose mufflers creates much of the unpleasant pounding and jarring of traffic, also causes louder exhaust cut-outs.

4. Equip all possible trucks with pneumatic tires.

For Radio Owners

1. Don't let loudspeakers in shops and dwellings rise above the natural loudness of the human voice. It is as inconsiderate to penetrate into other people's dwellings and places of business with the magnified tones of radio loudspeakers as it would be to enter and shout. Also, it is just about as likely to get you into trouble—see Judge McAdoo's letter of October 24th to magistrates in New York City.

For Householders

1. Give the children the quietest rooms in which to sleep.
2. Use sound-absorbing rugs, draperies, screens, and shelf-linings—especially in bedrooms—to overcome noises entering from the outside.

3. Don't give parties often enough to get on the neighbor's nerves.

4. Don't indulge in loud music, laughter and conversation after the children have gone to bed unless their rooms are insulated against noise from the rest of the house.

5. Use shock-absorbing ash cans. A mat of hemp or rubber fixed to the base of the can will take care of this or mats can be placed on the sidewalk to receive the cans.

6. Dog owners should endeavor to keep their animals quiet.

For Office Workers

1. Make the fullest use of sound-absorbing partitions and screens both to dull the office-caused noise and to absorb street noises.

2. Put noisy machines where they can least disturb everyone concerned and make full use of mats to absorb vibration and of screens and partitions to absorb sound.

3. Speak directly into the phone—there is no need then of speaking so loudly that others in the office have to hear your conversation.

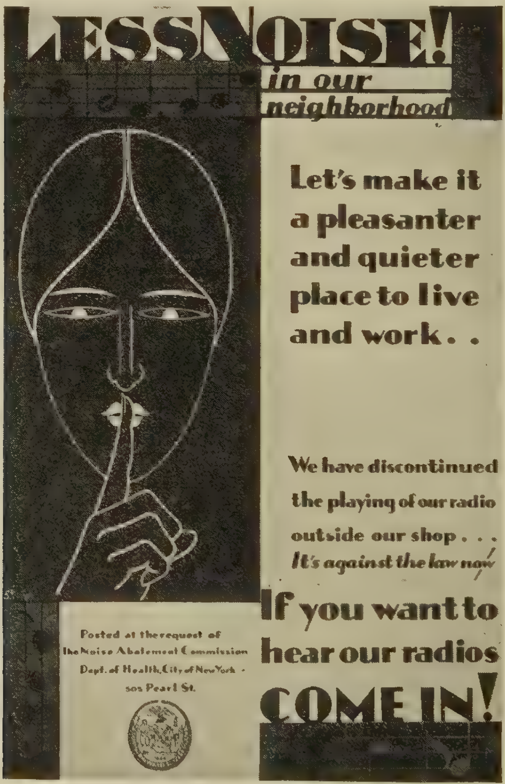
Etiquette for the Street

1. Young people should refrain from front stoop concerts during reasonable sleeping hours for the people in the neighborhood.

2. Taxi-drivers waiting at all night stands should refrain from loud talking.

3. Doormen should use flash light signals or number board signals instead of whistles as soon as darkness falls.

4. Milkmen and garbagemen should refrain from shouting while they are on their rounds.


LESS NOISE!
in our neighborhood
Let's make it a pleasanter and quieter place to live and work . .
We have discontinued the playing of our radio outside our shop . . .
It's against the law now
If you want to hear our radios
COME IN!
Posted at the request of the Noise Abatement Commission Dept. of Health, City of New York - 505 Pearl St.

Poster displayed by 3009 radio shop owners beginning on August 1, showing their cooperation with the Noise Abatement Commission

What Price Noise?[1]

AS is fitting and proper at this season, I'll begin by wishing you a Merry Christmas and many of them—each less noisy than the last. With the noise of modern mechanistic civilization diminished, "peace on earth and good will toward men" would stand a much better chance of realization.

There's a curious thing about noise. It started out by being one of the best friends of man, warning him against danger or telling him where to look for food. The roar of preying beasts told him to be on the alert against death in the forest. The bellowing of herds told him there was good hunting on the plains.

Imagine one of the leading cave families in late paleolithic times, all settled for the winter in a high dry cave. When they heard the roar of a hunger-mad saber-toothed tiger, the children cowered in the far depths of the cave. The women leaped from their cavewifely jobs to help their warrior—gave him his bow and arrow, handed him his hunting javelin and his javelin thrower made of bone; then they took their stand at the entrance of the cave while he went forth to fight.

In the meantime, something had happened to the caveman—something he did not understand, but something that he depended on very much to help him combat danger. His muscles grew taut; his hair bristled; he lost interest in food—even the most tempting piece of broiled bison; he breathed rapidly; he felt his heart beating differently. He was undergoing what twentieth century psychologists call the fear reaction, but he would not have called it that. He only knew he felt very fit and very brave.

The "Fear Reaction"

But both the cave man and the modern psychologists are right—the man had to be frightened in order to be brave enough to fight that saber-toothed tiger, a monster so huge and so ferocious that its like is not known in the world today, an animal fitted to prey upon the mammoths and other gigantic beasts of that bloodthirsty time. Compared to the saber-toothed tiger, the caveman was a pretty puny foe; yet he had that precious "fear reaction" that made him a redoubtable opponent. The chances are our hero brought home the body of the wild beast and his family gave him deep paleolithic respect because they knew their saber-toothed tigers. Without the "fear-reaction" he would have been a rank failure as a defender and provider; with it he was a howling success and his family lived long and prospered.

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[1] Radio talk given by Edward Fisher Brown, Director, Noise Abatement Commission, over Station WEAF, Tuesday December 17, 1929.

Don't imagine for a minute that the caveman did not feel the extra exertion he put forth when under the inspiration of this fear reaction of his. He usually came home, worn out—exhausted by the extra expenditure of energy necessary to fight wild animals or enemies, as the case might be. Then is when the women of the family busied themselves. They gave him herb tea to drink—strange infusions the formulae for which were handed down from mother to daughter; they rubbed his tired limbs with oil; they prepared a feast for him. After he had eaten he sank into well earned sleep.

Man's Most Faithful Sentinel

In the course of time—and I mean the long long ages that brought a change in the shape and climate of whole continents—man changed too, but he hung on to his hearing and his reaction to noise. He needed them. Hunting and fishing, herding and farming, he needed to be on the alert at all times. Besides, he had to be ready to fight other men who wanted his possessions. In those days of rough and ready justice—of "an eye for an eye and a tooth for a tooth," the ear was man's most faithful sentinel against destruction.

Even within the memory of men now living this primitive equipment was a mighty powerful help in time of trouble. In the pioneering days of the West, it was the man with the quickest hearing and the most ready fear reaction who stood the best chance of surviving.

So here we are in the midst of a modern civilization—where noises have no particular meaning—responding to them in the

When the noise problem around Central Park involved only barnyard sounds

old traditional way. Who hasn't jumped at the explosion of an automobile backfiring—for all the world as if he expected an attack by Indians? Who has not cringed at the screeching of brakes as if he feared the approach of strange forest animals?

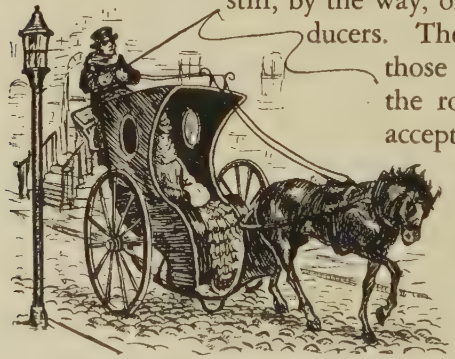
Naturally, we don't jump at every city sound we hear—we would be jumping pretty nearly all day long, if we did. We have schooled ourselves to go ahead with our jobs and get them done somehow. But experiments show that there is an unconscious response to loud sounds—the old fear reaction still on the job—a response that takes its toll from us to a certain extent just as it did from the caveman. Perhaps we do not expend the full amount of energy the caveman did who went out and killed his tiger, but when we are working against noise we do expend more energy on our tasks than is necessary.

When you consider the piled up energy used this way throughout the day—a day made up of hours during each of which we are exposed to as many startling sounds as the simple caveman was in the course of his lifetime—you can readily see why people complain that noise tires them out.

Unmeaning, senseless noise is such a new thing in the world that we can hardly be expected to grow accustomed to it. The last fifty years have seen New York changed from a comparatively quiet city to a veritable jungle of noises—changed by the inventions and devices we have created ourselves—changed and still changing!

But people have not been able to change so rapidly. Girls of today may go out into the business world instead of staying home and embroidering doily sets with California poppy devices as their mothers did—young men may be airminded instead of devoting their thoughts to racing their trotters along the Speedway and Ocean Parkway as their fathers did, but the fact remains that New Yorkers still are the same old-model human beings that have been in use for centuries and they find themselves living under conditions utterly different from any the world has ever known before, as far as noise is concerned.

It is hard to say just when New Yorkers began to realize that noise was a nuisance. Old timers tell of the coming of the "L"—still, by the way, one of our greatest noise producers. They were disturbed, especially those who lived or worked along the route of the tracks, but they accepted it in time as a necessary evil, and rejoiced that they had the great benefit of rapid transit. After all, they could not realize that the modern mechanical age would bring on anything that would harm them.



Carriage wheels against cobblestones

When the rumble of iron tires on rough stone paving became too annoying, New York adopted the new-fangled asphalt paving. By 1898, this quieter form of paving was spreading throughout the city and the people enjoyed the relief.

Mrs. Isaac L. Rice, with the help of Columbia law students and other public spirited citizens, reduced the horn-blowing of watercraft on the Hudson River. Later, a children's auxiliary of Mrs. Rice's organization, under the presidency of Mark Twain, agitated for quiet on hospital streets.

So New Yorkers moseyed through the gay nineties and the early nineteen hundreds. They grew mildly peeved at times when the German band played too long on the street corner. They roused themselves to protest against the cries of truck drivers urging their horses on by word of mouth and crack of whip, but part of their ire was due to the mistreatment of the horses. Individuals protested against the rasping of talking machines, but for the most part people were so fascinated by the new contraption they did not quarrel with the noise. Neighbors of opera aspirants got considerably "het up" over the trilling and gargling and gurgling that issued from ambitious throats.

A quaint custom of the period was the keeping of parrots. Nearly every household, especially in the more congested neighborhoods, had its parrot and nearly every housewife hung her pet outside the window for a part of the day to get the sun and air. I remember reading a story called "The Vampire of the Slums," in which a parrot with its eternal babbling was the evil genius of a whole neighborhood. I wonder if a parrot could be heard now in the daytime rumble of the lower East Side.

Other birds bothered people too. Many irate citizens complained about that symbol of peace—the dove. More exactly, they complained of whole flocks of doves and said their combined cooing was downright "thunderous."

Any oranges, limes or lemons!

And roosters—a good many people kept chickens in their backyards in those days when the city was simpler. Curiously, roosters will be roosters and crow at their set times during the night and to greet the dawn—habits not at all conforming with the sleeping customs of city folks!

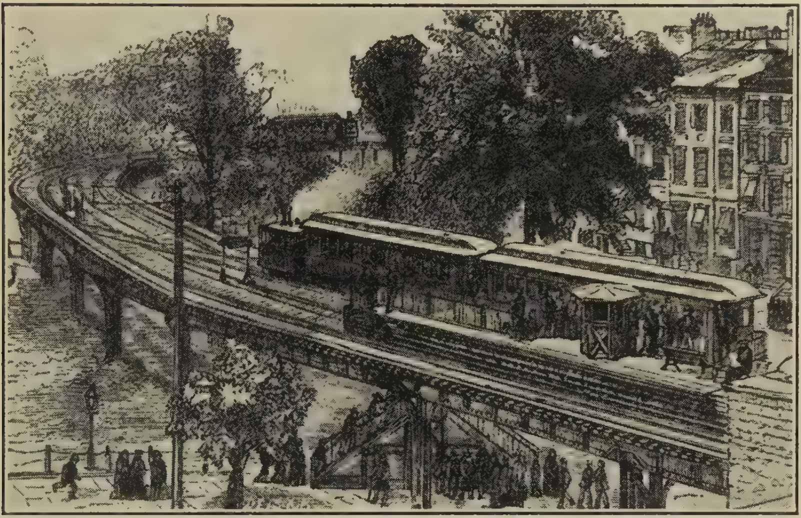
And in the meantime something fundamentally disturbing happened to the city—the riveters came to town. It is hard to get New Yorkers to say just when this happened. Each man or woman remembers only the first time he stood in awed wonder watching these men toss red hot rivets, catch them in a bucket, and then thread them into place and work on them with the rapping riveting machine. It was more thrilling than the circus. And the result—the skyscraper—was the most thrilling architectural effect ever yet achieved.

The Skyscraper Age

So New Yorkers enjoyed their pride in skyscrapers and patiently stopped their ears when the riveting was going on. But while one skyscraper went up in the early nineties, five went up in the early nineteen hundreds—and more and more! The city by 1912 was described as the greatest unfinished city in the world. It is still unfinished.

Perhaps, New York—constantly unfinished as it is—conforms as no other city in the world does with George Bernard Shaw's theory that buildings should be torn down as soon as the generation that built them has passed on. We frequently tear our buildings down even before a generation has passed. This last year, acres of office buildings and residences were torn down to make room for nine super-skyscrapers, in the Grand Central District—I am almost tempted to call them super-super-super skyscrapers so completely do they dwarf the buildings of the past.

Naturally the wrecking of those old buildings added to the sum of city noises, but did not penetrate far beyond the immediate neighborhood. The body of sound came when the men working on the excavation and, later, the riveters began their work. It would have been a valuable contribution to science if the neighboring offices had kept tab on their production both as to quantity and quality while the noise prevailed.



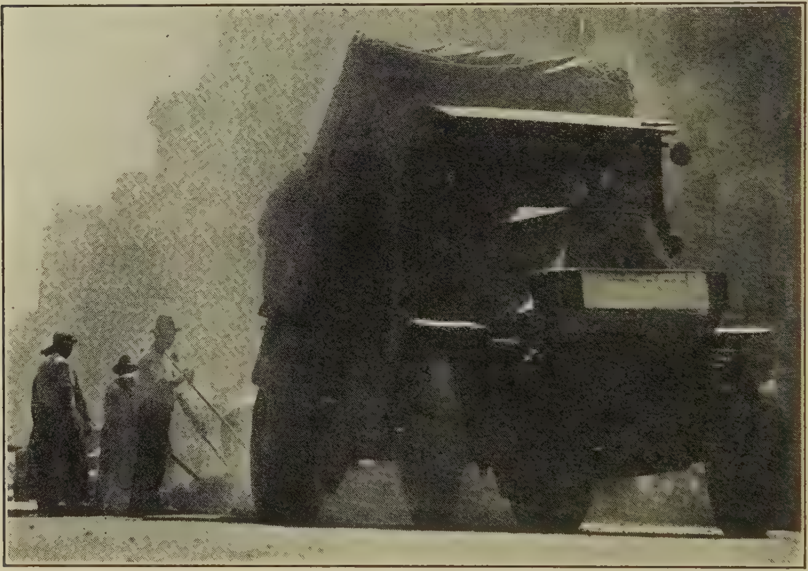
From an old print in the collection of the Museum of the City of New York

The coming of the elevated initiated the new era of rapid transit—and noise.

But noise is not over with, when buildings are finished—in fact, it has just begun. With the coming of buildings come people. And these people must circulate back and forth from one part of the city to the other to get their work done. Also other people come to call upon the new tenants of the new buildings—all in the course of the business day. So street traffic is increased—it is hard to estimate just how much—possibly doubled for every skyscraper office building in any given locality. And street traffic spells noise.

A great deal of that noise is unnecessary. Next time you see a traffic wait, count the number of cars waiting in back of the line tooting their horns without reason and without sense. The drivers know well that they can move on only when the traffic lights change, but such is their nervous impatience—possibly a reflection of their passengers' nervous impatience—that they toot the horn. This certainly does not relieve the nervous impatience of everyone else in line—in fact increases it and makes others toot their horns who otherwise would not have done so. Anyway, the clamor is there—the unnecessary din. Multiply this by the number of traffic waits at different streets and you will get some idea of the extent of this noise nuisance.

But that is only one part of the general rumble and roar of traffic. You who have offices facing on a busy street know how often you have to close the windows before you use the telephone. Even if there is no tooting of horns, there is the rumble of heavy trucks, the screeching of brakes, the chugging caused by loosened mufflers, all punctuated by the vicious put-put of fractious motorcycles.



There is engineering authority for the statement that quiet trucks and machinery in general may be made more efficient.

In calling to mind traffic noises, I have jumped ahead of my story to a certain extent. Street cars have been with us all along from the pre-automobile era until the present and consistently throughout they have called forth protest. The clang of wheels crossing switches, the ringing of gongs, the rumble of wheels against the hollow rigid street. Recently the Chicago Department of Health suggested sound absorbent pads be placed the length of the tracks to eliminate the chief noises of street car traffic.

As the city has grown in size the number of ash cans and garbage cans that must be emptied has increased proportionately. Where once the collectors could empty the cans and place them back on the sidewalk, now they must work at extra speed—they hurl the cans about with great clatter.

With modern commerce has come the truck—on city streets and country roads. It not only makes noise, but often vibration that shakes buildings.

Airplanes buzz and hum over head. Once they were a curiosity and no one seemed to resent their roar; now people are interrupted many times a day by their sound.

The advertising planes equipped with loudspeakers already have had their rise and fall from popular favor—perhaps the quickest flirtation with popularity, in recent advertising experience.

"Getting Even" with Noise

Then comes the medley of noise made by human beings in the process of trying to enjoy recreation. They seem to enjoy making noise—throwing wild parties, letting the radio loud speaker go full blast late at night, making whoopee. It is possible they are only trying to get even with the noise of our modern civilization. It is enough to stir the savage vindictiveness of even the most civilized at times.

But what can we do about it? A great deal! The Noise Abatement Commission appointed by the Commissioner of Health, Shirley W. Wynne, two months ago, is already testing the noises of the city and working out recommendations for lessening them.

It is a problem. How are they meeting it will be told in the talks following mine: the measuring of a great city's noise, how noise affects human beings, how we can actually stop many noises, and a vision of the future work.

Is There a Quiet Spot in New York?[1]

NEW YORK CITY is situated in an invisible jungle—a jungle of sound and noises. This bewildering community where towering growths of sound climb up to the top of the highest skyscrapers and where the rumble and roar of traffic spread like the undergrowth of roots and brush in a tropical forest is now being charted by the men who are handling the noise survey for the Noise Abatement Commission.

These men have found a few clearings in this dense jungle—the quietest outdoor spot they have found so far in their search being the Mall in Central Park, although it is only as quiet as a fairly quiet office—due to the general city noise that reaches it. Curiously, other reasonably quiet spots are the first stories above the setbacks in the modern type of skyscrapers. Three years ago in a survey made for the *Forum,* Dr. E. E. Free found the interiors of city blocks—that space formed by the combined backyards of many buildings—as quiet as if they were in a country town. There is one very obvious explanation for the quiet of these three places—the Mall, the first setback story on each level of skyscrapers, and the interior of city blocks—and that is that they are shielded from traffic sounds.

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[1] Radio talk given by R. V. Parsons, Consulting Engineer, Johns-Manville Corp., over Station WJZ, Thursday, December 26, 1929.

Knowing this we can imagine a very livable city that would be quite topsy-turvy to the city we have. Wealthy people would have their apartments in alleys and on the inside of city blocks with buffer buildings of lofts and offices to protect them from traffic noise. Schools and theatres and hospitals would always be in the centre of the block. It might not be a very beautiful city or a gracious city, but it would have comfort of a kind.

It has always puzzled me why theatres, churches, and hospitals are so invariably placed right on the busiest traffic streets, when they could just as well be a step off those same streets—quite as accessible—and still have the protection against noise that buildings on both sides would give. These types of buildings should be placed in sound shadows.

Noise in Theatres

When you go to the theatre here in New York, you hear only about 65 percent of the spoken words. Of course, part of that is due to slipshod enunciation and insufficient loudness, but our theatres are set down in the very heart of the noise jungle, and street noises—like great tropic vines—find their way into the auditorium through leakage—by way of the firedoors, through the lobbies and foyers, through the ventilating systems, and even from the stage. A whole crop of noises grow luxuriantly in every audience—coughing, the scraping of feet, the movement and whispered conversations of people. And the actor must compete with this general noise level to be heard. Fortunately, the action of the play and your own lively interest enable you to understand much more than you actually hear.

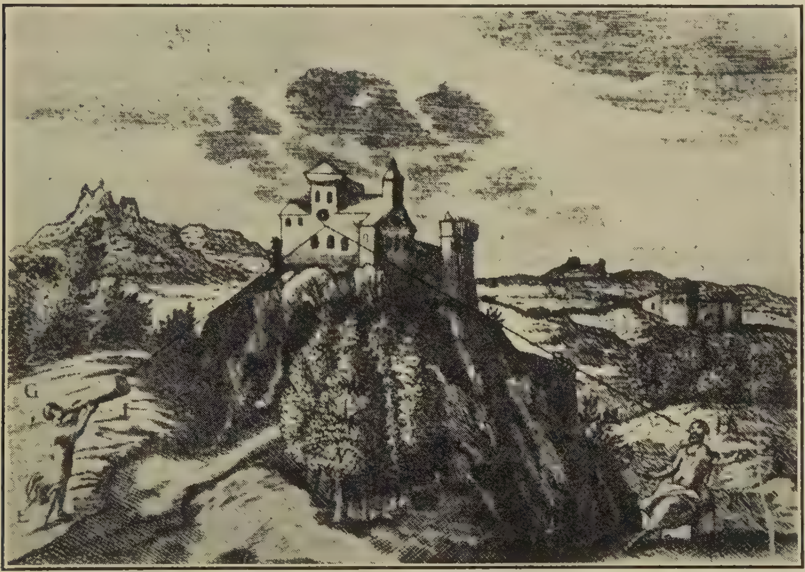
Several years ago the Detroit Symphony Orchestra gave its concerts in a dance hall auditorium with clere-story window ventilation. A malicious Fate seemed to set up a clamor of street cars outside whenever the most delicate passages were being played. One evening, when all the directors were present, a motor truck chugged past, followed by a flock of clanging street cars, just at a moment when a delicate pizzicato movement was being played by the string instruments. Mr. Murphy, the president of the association, went through the audience gathering the directors together and right after the concert they had a meeting. They decided then and there to build a sound-proof hall. The building was completed in seven months and it was truly sound-proof. In the first place, stores, offices, and lobbies formed a buffer between the traffic-busy street and the auditorium, itself. Heavy masonry walls and firedoors of heavy air-tight construction combined with vestibules full of sound absorbing treatment further protected the hall. Although street cars passed even nearer to this auditorium than they had to the other, they were never heard.

I regret with many others that the new Metropolitan Opera House in the centre of protecting stores and office buildings has been given up. It could have been a magnificent example of architectural ingenuity in protection against outside noise.

Doing Away With Windows

If we could do away with windows, sound-proof construction would be much simpler. It is, indeed, acknowledged that offices could be better ventilated and as well lighted without windows, but we must consider the fear of closed places that we all have to a greater or less degree, so that form of construction is out of the question. Windows we have and windows we will have for a long time to come. There is a crying need for a combined window ventilator and sound muffler that will work automatically when the window is opened—so as to shut out noises from the street—from our neighbor's radio, for instance, as well as to confine the noises produced in our own rooms—such as our own piano playing and radio loudspeaker.

When I say that sound-proof construction is possible, I must add that its expense increases, depending on the degree of sound insulation desired. Perhaps for a while only the rich man—the big business executive—the creative genius will possess offices and houses that are essentially sound-proof. As a matter of fact, there is danger in the complete exclusion of all sound from buildings, for then building noises, creaking floors, softly closed doors, running water—noises that are now generally submerged in the noise of the city, become aggravatingly apparent. But it is conceivable that every office organization could have two or three sound insulated rooms to be used by the staff. In a flight of fancy, I can even imagine some philanthropist of the near future endowing "thinking places"—sound-proof buildings where people could go to think out their problems—just as philanthropists have endowed libraries and colleges in the past.



From a 17th Century work on acoustics

An old conception of sound—illustrating how street noise is reflected back by high buildings.

But even for all of us better sound-insulated dwellings and offices are increasingly possible. And such sound resistance depends more upon the construction and design of the buildings than upon the materials used. For example, some way of separating ceilings completely from the floor above must be developed. I believe that architects can evolve a type of ceiling that will be independent of the steel supports of the building itself. Vibrations would be transmitted from the floor to the steel supports and thence to the ceiling, but most of it would be absorbed in the steel frame of the building and not set the ceiling to pulsating.

That much sound is dampened in this way is a familiar fact. Put your ear against one of the main columns of a building and you can hear the rumble and roar of the elevator, ventilating and pumping machinery in the sub-basement or pent-house. Take your ear away and you do not hear any of these sounds. The energy which might have originally caused the plastered walls to send off sound waves has been so dissipated or dampened in its passage through the structure that it is no longer capable of setting the plaster walls in vibration.

Even in buildings under construction, the noise of riveting would be deadened if the concrete were poured around the steel as soon as each level was completed. This is not practical, however. But there is a way the sound could be deadened during construction. If a huge block of stone or concrete were clamped on the crossbeam or column just before the steel upright is riveted into place, it would dampen most of the clang and clatter of the work.

Business Finds Noise a Hindrance

Business organizations have long recognized that greater quiet means greater efficiency. Last year, they paid over $3,000,000 to secure quiet working conditions for their employees. Their practical experience is borne out by the findings of psychologists. I was interested in Dr. Donald Laird's paper which he read before the last meeting of the Acoustical Society of America, in which he said that noise has an observable effect on the concentration, memory, speed, and output of students and mental workers—all important factors in the production of work in our modern world.

The facts and freaks of sound play a much more important part in our daily lives than we believe. For example, take the piano that you buy after hearing it played in a sales room, where the huge wide floor and sound reflecting walls and ceilings act as a gigantic sounding board, giving gorgeous volume to the music. You bring it home and place it in your heavily deadened apartment on the much smaller floor and you are surprised at the falling off in volume—you probably call it resonance. In fact, hundreds of pianos are returned to dealers simply for this reason. Suppose, in addition to placing your piano on the small floor of your own apartment you have consideration for your neighbors downstairs and do not want to set your floor and their ceiling pulsating with music, so you get little wooden blocks cupped out in the centre to support the piano's legs and you have the cupped part of the blocks lined with felt to further absorb vibration, you will be even more disappointed in the tone of your piano. Instead of utilizing the floor of your apartment as a sounding board, you have whittled it down to the bare dimensions of the piano.

Another thorny bush in our jungle of noise is the courtyard of apartment and hotel buildings. It is possible to deaden courtyard noises by treating the walls of the courts with porous material. There is one drawback to this—porous material absorbs the moisture of rain and snow, which freezes and swells, thus destroying the material itself in a short time. Yet, this difficulty could be overcome by building a glass roof above the courtyard with an airspace at the sides for ventilation.

Skyscrapers No Longer Insurance

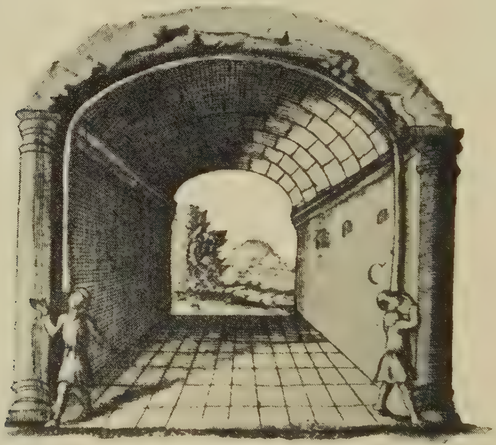
There used to be a time when, by climbing up into a skyscraper you were climbing into your own ivory tower of silence. That was when skyscrapers were few and far between. Now they huddle together and reflect the street sound back and forth. Even when you get above the level of the neighboring high buildings, you are not free from the city noise—then the sounds of the distant "L" and street cars, boat whistles, heavy trucks, and racing fire apparatus become apparent, although you do escape the traffic noises from the streets immediately below you.

Most sound can be quieted at its source much more effectively than it can be controlled later. When people demand quiet machines, they will get them. There is a certain chain-drive truck that at present seems to be the greatest individual nuisance in traffic noise. When public opinion decides against such noise, the manufacturers will hasten to conform with public opinion.

Already other traffic noises are in varying stages of solution. Trucks are increasingly being carried on pneumatic tires. Six-wheelers further distribute the weight of heavy loads and so diminish the impact against the road and also the rumble in traffic.

More and more, people are complaining against the honking of motor horns. I, for one, believe with Dr. Free and Abbe Dimnet that motor horns should be done away with entirely.

In the final analysis, the whole question of noise abatement rests with the people of New York. If they want it they will get it. Preventing noise at its source and insulating against it are both possible now—not in some Utopian future. To paraphrase the golden rule—let us consider the ears and nerves of our neighbors if *we* would live in peace and quiet.



From a 17th Century work on acoustics

How sound is carried across an arched tunnel—an explanation of much subway noise

How Noise is Measured and Why[1]

SINCE the formation of the Noise Abatement Commission by Health Commissioner Wynne, the public has not only been very sympathetic to its purposes, but has manifested considerable interest in its activities. One of the questions frequently asked is, "How can you measure the noisiness of noise?" You have probably heard that we are now taking a survey of the noise in New York City. It is the purpose of this talk to tell you how this is done.

Instead of saying that the noise is "loud" or "faint," we describe the noise more accurately by saying that it is so many decibels above the zero loudness, or above the faintest sound that the average ear can hear. In other words, the decibel is a unit used to describe the amount of noise.

What "Deafening" Means

We will now perform an experiment to illustrate the meaning of this unit. If your radio set is adjusted so that my voice sounds like average conversational speech to a listener who is about three feet away from the speaker, then the noises which you will now hear will be at the intensity levels which I will indicate. The intensity level of such speech as you are now hearing is 70 decibels above zero loudness. We will first let you listen to the noise from a room filled with persons using typewriters. The level is 70 decibels. (Reproduce noise for two seconds at a level of 70 decibels.) Here is a noise from an automobile horn when the listener is ten feet away. The level is 90 decibels. (Automobile horn will now be blown.) As I am talking to you the horn will be blown* and you cannot hear what I am saying, but as the horn stops* the speech again stands out against the quiet background. Now we will listen to the applause at one of Lindbergh's receptions; it is at a level of 90 decibels. We will next take you to 34th Street and Broadway and let you listen to the traffic noise. It is at a level of 75 decibels. (Reproduce traffic.) As we move away from this noisy corner, the noise drops 10 decibels, as indicated. (Reproduce traffic noise with 10 decibels lower level.) Now it is reduced another 10 decibels. (Further reduce noise 10 decibels.) Now still another 10 decibels. (Reduce noise 10 more decibels.) This will help you to realize what an intensity change of 10 decibels means.

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* . . . . * indicates period of horn sound.

[1] Radio talk by Dr. H. Fletcher, Research Engineer, Bell Telephone Laboratories, over Station WEAF, Tuesday, December 31, 1929.

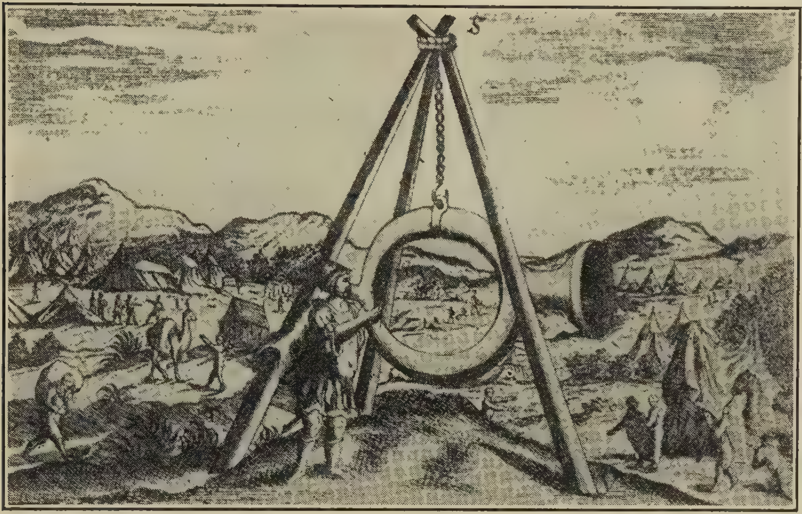
For measuring such noise levels, a piece of apparatus known as a noise meter is used. It consists of a sensitive microphone or sound collector which converts the sound waves into electrical currents. These currents are amplified in much the same manner that your radio set amplifies my voice. Instead of going to a loud speaker, however, the currents pass into an electric meter and are measured by the deflection of the meter needle. The device has been calibrated so as to read directly the intensity level of the noise above threshold or zero loudness.

Noise Made Up of Many Tones

Noises, as you know, are made up of a number of component tones, some of low pitch and some of high pitch. By the use of electrical filters, a meter reading is obtained for various pitch ranges of the noise. Thus the fraction of the noise in any part of the pitch range, that is, the low, the medium, or the high pitch range, may be obtained. It is possible, therefore, to measure not only the overall level of the noise, but to measure as well how it is distributed in pitch, in other words to describe accurately the quality as well as the quantity of the noise.

Besides knowing the level of the noise, it is also important to know how much the noise limits the ability to hear other sounds. Therefore, a second type of measurement based upon this deafening effect of the noise is being made. To make clear this method, I shall now perform another experiment. I want you to listen to the following three tones: 1, warble tone, low pitch; 2, warble tone, middle pitch; 3, warble tone, high pitch.

As you have noticed, these three warbling tones are composed of components in three different pitch ranges, low, medium, and high. Now listen again to the second tone while I change its intensity in steps of ten decibels: 1, warble tone, middle range, 80 decibels, 4 seconds; 2, warble tone, middle range, 70 decibels,



From a 17th Century work on acoustics

The horn by which Alexander the Great called his armies together could be heard over ten miles away—about the same distance many automobile horns can be heard.

4 seconds; 3, warble tone, middle range, 60 decibels, 4 seconds; 4, warble tone, middle range, 50 decibels, 4 seconds.

The intensity of the tone was changed in steps of 10 decibels. As the intensity is decreased, a point is reached where the tone is just audible in a quiet place. The intensity of the tone at this point is called the threshold intensity of zero loudness. It is the just audible intensity of the tone.

These tones are called "warble tones," and they are the tones that are being taken about New York City to measure the city's noise. For convenience, they have been recorded on phonograph records, and, by means of a portable phonograph, are reproduced at the localities where measurements are desired.

Now let us go again to one of New York's noisiest corners, Sixth Avenue and 34th Street. When we arrive there you will hear the roar and din of the city's traffic. (Phonograph reproduction of traffic noise—several seconds.)

While you are listening to the traffic noise, I will increase the intensity of the warble tone that you listened to a few moments ago, until you can just hear it above the roar of the traffic. (Increase warble intensity until clearly audible—4 seconds.)

Then leaving the warble tone unchanged, we will suddenly stop traffic for a few seconds. (Cut traffic noise—4 seconds.)

In order that you may get a clear contrast between the two intervals we will again start and stop the traffic: 1, introduce traffic noise—4 seconds; 2, cut traffic noise—4 seconds; 3, repeat 1 and 2.

You were no doubt very forcibly struck by the fact that the warble tone, although just audible in the presence of the noise, was considerably above the just audible point when the noise ceased. In other words, the threshold intensity in a noisy place is very much greater than the threshold intensity in a quiet place. The effect that you just observed was caused entirely by the masking effect of the traffic noise and took place in your own ears. No changes of any kind were made in the warble tone when the traffic noises were switched on and off. A measurement of this kind indicated that at this corner the deafening effect was 50 decibels. To appreciate what this means, I will say that the physical intensity of a tone must be one hundred thousand times greater to be heard in this noise than if it were perfectly quiet.

The Measure of Noise

The test that we have just made is one that is being carried on throughout the city of New York. The warble tones are reproduced electrically by the phonograph and go to a telephone receiver that is provided with a special receiver cap. This cap is slotted so as to permit the street noises to enter the observer's ear along with the warble tone. The observer simply adjusts the intensity of the tone in the presence of the noise until it is just audible. The difference between this intensity value and the threshold intensity in a quiet place is a measure of the amount of noise present. These measurements are carried out with each of the three tones that you heard.

Since the method just described involves the human ear, it is called an audiometric test, and the curve that is obtained with the three warble tones, corresponding to different pitch ranges, is called the noise audiogram.

Why the Survey Is Needed

There are at least three reasons for measuring the noise throughout the city of New York. In the first place we wish to know something about the level of the noises to which we are subjected; we wish to know where and at what times they occur. Information of this kind is necessary to determine the amounts of any changes that may take place in the city's noises. For example, if the traffic on our streets continues to increase as time goes on, any increases in the noise may be ascertained by using the present noise survey as a reference point. On the other hand, if various means are used to bring about an abatement of noise in the future, the present noise survey may also be used as a reference point in measuring the amount of the improvement.

In the second place we wish to determine the part that specific sources, such as trucks, trolleys, building operations, etc., contribute to the aggregate noise. Information of this kind is necessary in order to carry out intelligently any program of noise abatement. Suppose, for example, it is found that trucks in a bad state of repair are the principal contributors to the city's din, or that a bad rut in a frequently used street accounts for most of the noise in the immediate locality. With information of this kind at hand, the steps that need be taken to bring about the greatest abatement will be immediately evident.

In the third place the questionnaire which was recently circulated by the metropolitan newspapers has given us some notion of the annoyance caused by various noises. It is important to determine how the annoyance as revealed by this questionnaire is related to the part that a specific noise contributes to the aggregate noise at various places and times. It is also desirable to know something of the pitch range and loudness of specific noises that cause greater or less annoyance. When information of this kind has been obtained, it will then be possible to make recommendations for noise abatement not only with an eye to their feasibility, but also with an eye to the resulting improvement in the city's noise.

City dwellers are exposed to noise at home, at work, and on their way to and from their daily labors

What Noise Does to Human Beings[1]

TAKE the average New York man: He awakes from slumber first when he hears the people across the street come home around three o'clock in the morning. Most likely he manages to get to sleep after that just in time to be awakened by the tintinnabulation of the ash collectors on their rounds. He dozes off to the anti-lullaby of the milk delivery. Pretty soon the children in the apartment above stage a rough house that seems likely to bring the ceiling down on his head. Or maybe it's his own children who disturb him by popping into his room to tussle and romp—anyway he's wide-awake now. Then he has breakfast and dashes to work. Whether he dashes on the subway or on the street car or on the bus, he is exposed to just about the same degree of noise. He reaches his office, where he is subjected to the lusty clang of typewriters, adding machines, and ventilating fans, or to his shop where he hears the constant whir and feels the vibration of machinery and the loading of trucks. (Of course, if he's a librarian, he can sit all day protected from the noise of the world by books, but so few of us are librarians.) By noon, he's quite ready for food and goes to a restaurant, where dishes clang and clatter in the full rush of lunch hour. Back to his work and its special noises. Then home through the noisy streets. At home he may have peace—and he may not, depending upon his family, his neighbors, the talk at his dinner table, and the conversational powers of the taxi drivers at an all-night taxi stand on the corner.

Children Exposed to City Noises

Children, who need their full allotment of sleep in order to grow properly, are exposed to these city noises. Expectant mothers who have been ordered by their physicians to get rest through the day and to sleep long hours at night have to listen to the turmoil of the city. Invalids—and not all invalids are in hospitals by any manner of means—invalids must put up with the din of the day and the night, although they scarcely have strength to combat their illness.

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[1] Radio talk by Dr. Foster Kennedy, Noise Abatement Commission, over Station WEAF, Tuesday, January 7, 1930.

A large proportion of the ills which affect the community result, directly or indirectly, from the development of a mechanical civilization. Over-crowding and congestion in big cities has led to lack of necessary health factors: exercise, fresh air and sunlight; pollution of the city air by smoke and commercial extraneous gaseous exhaust products has been investigated and partly controlled but it is only recently, however, that any public attention has been directed to noise as a social evil. We have grown up without noticing its gradual increase, but anyone who pauses to listen to the hubbub of a New York City street at noon will realize how noisy civilization has become. Motor cars constantly sounding electric horns, commercial trucks crashing and rattling, hawkers crying, tugboats screeching, trains thundering beneath, and aeroplanes roaring above make a monstrous clamor; and the road-mender's pneumatic chisel and its twin brother the steel-worker's riveter complete the pandemonium.

Authorities Declare Noise a Menace

Probably most city dwellers find noise an intermittent nuisance but several well known authorities have declared that it is a definite menace to the public health. The effect of noise on human beings has been studied by the British Medical Association and by the Noise Abatement Commission of New York.

Noise does something definitely harmful to everyone in our city. Not only should hospital streets be made quiet, but every street. In all these great modern apartment houses the drama of life is going on—birth, living, sickness, and death. And city noise can play a harmful part in every phase of this drama.

There are three kinds of people to be considered in this regard: 1, normal, insensitive persons; 2, normal, sensitive persons; and 3, invalids. Possibly noise is less consciously an annoyance to the first class—normal, insensitive persons; but baneful things happen to everyone whether he is aware of them or not.

Tests we have been making at Bellevue in the Department of Neurology show this. In these wards there are always persons who in the past have required operations on the skull with the removal of bone and replacement of scalp, such operations having been done because of old skull injuries or for the removal of tumors or for other causes. We used several patients of this type, otherwise in perfect health, to test pressure on the brains under different circumstances: quiet, noise, and under the influence of certain medicines.

It was possible to get an accurate written record of this pressure by placing a small drum containing a partial vacuum on the soft area of the head. This was painless to the subject. The drum registered all the vibrations in the brain lying against and underneath it by communicating the vibrations to a fine recording needle that impinged on a carbon-blackened paper on a revolving drum.

Noise and Brain Pressure

First, the normal pulsations of the brain and its pressure were recorded on the carbonized paper and, then, the pulsations under the influence of noise. We used paper bags, blown up and then exploded, in one experiment and found that the explosion raised the brain pressure to four times normal for seven seconds and this pressure although not remaining as high did not come back to normal until 30 seconds had passed. Further, morphine and nitroglycerine raise pressure on the brain more than any other drug, but sudden noise raised it suddenly more than did hypodermic injections of morphine or nitroglycerine.

I would like to ask the public of New York: If this is what an innocent paper bag explosion does to your brain, what does an unmuffled motor truck do to you?

The effects of noise have been described by research workers as emotional. However, long before the emotions are actively disturbed there are disturbances by reason of the stress of vibrations in heightened pulse rate, heightened blood pressure, some irregularities in heart rhythm, and, most important of all, in the increase of pressure on the brain, itself, as our experiments have indicated. Emotion is only the end product of the process; the undoubted effect of constant noise is disturbance of the blood vessel apparatus and the increase in the degenerative processes in the heart and arteries.

In a city like this, where there are brain workers, children, expectant mothers—to mention a few of the people who are likely to be adversely affected by noise—it is vital that we should abate the trying noises as soon as possible.

The fact that people cannot concentrate so well under the influence of noise has a profound influence on our daily working lives and on the work of school children and college students. It often means that whole hours of the day are completely wasted, because if we do not concentrate well we cannot remember—only those ideas on which we have trained the full searchlight of our conscious mind become clearly recorded in our memory.

Children may sit all day in the noisy schoolroom never learning how to focus this searchlight upon the facts before them. They may finish their full years of schooling and have no clear pictures in their memory.

Employers already have learned that workers do not produce such faultless work or such a quantity of it under noisy conditions as they do under quiet conditions—whether the work is intellectual or material.

Hearing Likely to be Impaired

The effect on the worker: The fact that hearing is likely to be impaired in those exposed to loud noises actually brings about a deterioration in the efficiency of the worker that shortens his years of profitable activity. This is another example—a cruel example—of the harmful effects of noise on human beings. Undoubtedly, we should include progressive deterioration of hearing in workers in noisy trades as a work hazard to be compensated by insurance—paid for either by insurance companies or by the employer.

Ten years ago there were listed twenty-five noisy trades, whose workers were known to suffer from this industrial deafness. To-day, taxi driving and truck driving can be added to that list of twenty-five.

Ten years ago there were listed twenty-five noisy trades causing deafness —now there are more

It has been shown that hearing is definitely affected in those persons who are constantly exposed to loud noises. Some German experimenters (Deutsch. Med. Welt. 3:283 Feb. 1929) have demonstrated direct lesions of the internal ear caused by noise. These lesions manifest themselves in the forms of ear noises, dizziness and headache. Factory and traffic noise almost exclusively exert an influence upon the general condition of the affected individual.

Noise interferes very seriously with the efficiency of the worker. It lessens attention and makes concentration upon set tasks difficult. The first effect of noise is one of disturbance, of excitation and of irritation. These effects have consequences of many kinds in conduct. They cause loss of temper, they play a part in quarrels, and they prevent deep and sustained thinking. In attempting to overcome the effects of noise, great strain is put on the nervous system—leading to neuraesthenic and psychasthenic states.

Noise may break or interrupt sleep, may make sleep disturbed and unrefreshing, or may produce insomnia. The effects of insomnia on night workers, who can obtain sleep only during the day, and upon sick patients in the hospitals must not be overlooked. The lack of sleep or the inability to obtain refreshing sleep—because of noise—represents a definite insult to the organism's normal physiology. Mr. E. B. Turner reported his observations to the British Ministry of Health and, speaking as a general practitioner of long experience, said that he had watched the effect of the irruption of a constant stream of noisy traffic into a previously quiet residential district, where the inhabitants, who before had been healthy, developed numerous disorders.

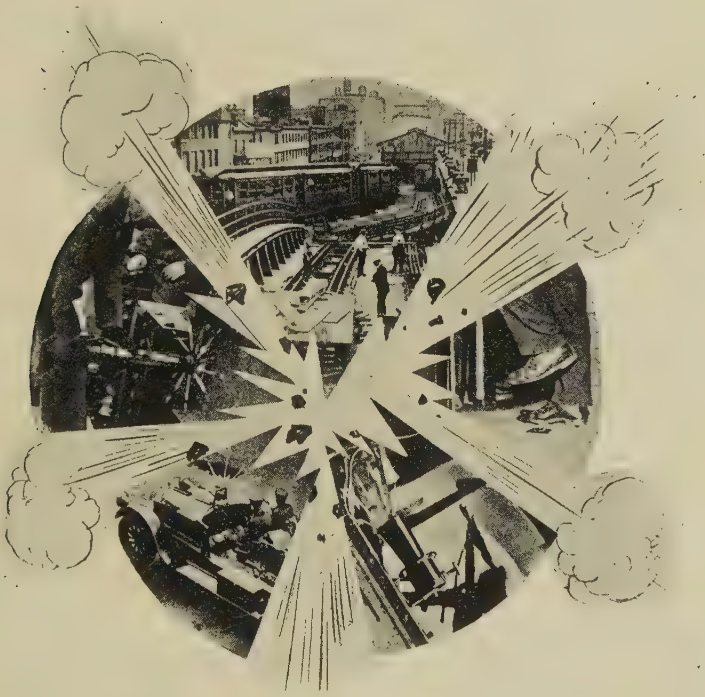
Growth Affected by Noise

Investigations at Colgate University by Dr. Laird have shown that young animals kept in quiet cubicles consumed more food and their rate of growth was accelerated more than that of their brothers and sisters who were kept in cubicles with noise, and several medical authorities agree. It is a well established fact that the normal development of infants and young children is seriously interfered with by constant loud noises. (D. A. Laird, Oct. 1927, J. Ind. Hygiene.)

It has been shown experimentally that there is a difference of 19 per cent in energy expenditure increment after working in a noisy as compared with a quiet environment. This additional energy expenditure is of course the notable factor in the development of fatigue in workers in noisy factories.

So it is no snap opinion but a proven fact that, to the busy brain worker, to the sick, the nervous, or the wakeful, noise is a serious menace to which adaptation may be impossible. It is sufficient that many nervous people are peculiarly susceptible to all kinds of vibratory stress, and they have at least the right to be protected from those unnecessary noises that the ordinary man resents. This resentment may well serve as our standard; for our unsophisticated likes and dislikes are reasonable guides to conduct, and did not, for example, await the progress of science to tell us that fresh air and sunlight are better than smoke pollution. We need not wait for further scientific proofs of ill effects from noise, our desire for peace and quiet is the justifiable foundation of the campaign against it.

We may by legislation end many noise nuisances—but only the development of a strong civic sense in each of us as to the care of the rights of the other fellow will make our city fit to live and grow in—and that civic sense must first be pushed into our own children and driven home in our own nurseries.



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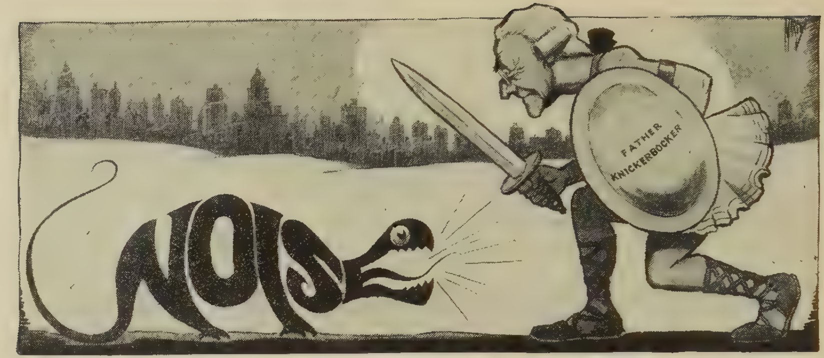

By Marcus in *The New York Times*

Why a Noise Abatement Commission?[1]

WHEN all that is happening in the world today becomes history and your grandchildren and great grandchildren study about it in school, they will very likely ask, "What was this noise people were talking about anyway?"

And if you are there to answer their questions personally, I hope that you will have difficulty explaining the matter to them. I hope that when you say "screeching brakes," for example, the youngsters will laugh at you and say, "Don't be silly. Brakes can't screech—anyway I never heard them in my life." And, when you try to tell them how trucks rumbled, how unmuffled exhausts whistled and exploded, how the neighbors kept their loudspeakers going full blast after midnight, I hope the children will not understand a word you say—simply because conditions will be so much more civilized than they are today.

Civilization is a queer thing. I suppose the bloodthirsty hordes of Attila, the Hun, thought themselves civilized, but they could not enjoy the countries they conquered until they caught up with the things they found there. In just about the same way we have conquered a new world—the world of invention and achievement, but we aren't going to enjoy it to its full until we have learned how to use it.

Take the very invention which makes it possible for me to talk directly to you—radio. There never before in history has been such a quickener of men's minds and sympathies. It has enabled us to keep in touch with Byrd on his Antarctic expedition as closely as if we were along with him. It brings fine music, lively entertainment, political issues directly to the majority of people. I have been happy in the privilege of using it to broadcast health news and suggestions. But many people are thoughtless—uncivilized—in its use. I think this is sharply illustrated by a letter I received not long ago from a mother who had heard my talk on child health in which I said children must get long hours of sleep. She said, "How can my children sleep when the neighbors across the way keep their radio on at its loudest far into the night?". . . . Obviously the fault is not with radio at all, but with people who have not developed their consciousness of the rights of others.

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[1] Radio talk by Shirley W. Wynne, M.D., Dr. P. H., Commissioner of Health, City of New York, Over Station WEAF, Tuesday, January 21, 1930.

It is so with our use of many of the other tools of daily life.

Then, on the other hand, some of our tools are still faulty—they do make noise. Among these are chain-drive trucks, pneumatic drills, and the ever-present ash can. All of these things can be made more nearly noiseless. Even the sound of riveting can be dampened as Mr. Parsons told you in his talk a few weeks ago. And, of course, there is the possibility that electric welding will be made a safe method of skyscraper construction in the near future.

Noise a Recent Growth

The important thing is that only in recent years have we begun to realize that noise is a hindrance to our activities and a real menace to our health and well-being. Until then we were proud of the hubbub we stirred up with our enterprise and our machines; we considered that noise spelled progress and success.

Night noises—according to letters we have received at the Department of Health over a period of years—seem to be the first to din their way to the attention of people. As night trucking became heavier due to traffic congestion in the daytime, complaints became more numerous. Other night noises also disturbed New Yorkers—the loud conversations of taxi-drivers waiting at all-night taxi stands, the singing of Sweet Adeline and other favorites by front-stoop choruses, the unnecessary honking of automobile horns, the blowing of doormen's whistles, the clanging of street cars, the squeaking of brakes, the collecting of ashes, the delivery of milk. . . . People were growing fretful, robbed as they were night after night of the full measure of their rest.

Day noises take their toll. Business offices, quick to check up on the production of their staffs, decided to use all the ingenuity of builders to keep out the exterior noises and to dampen the noises arising within the office, itself. School teachers became alarmed over the way noise interfered with recitations and study periods; they found that continued din actually held up the year's course of study—not to mention the drain on the energy of school children.

Doctors Finding Out Effects of Noise

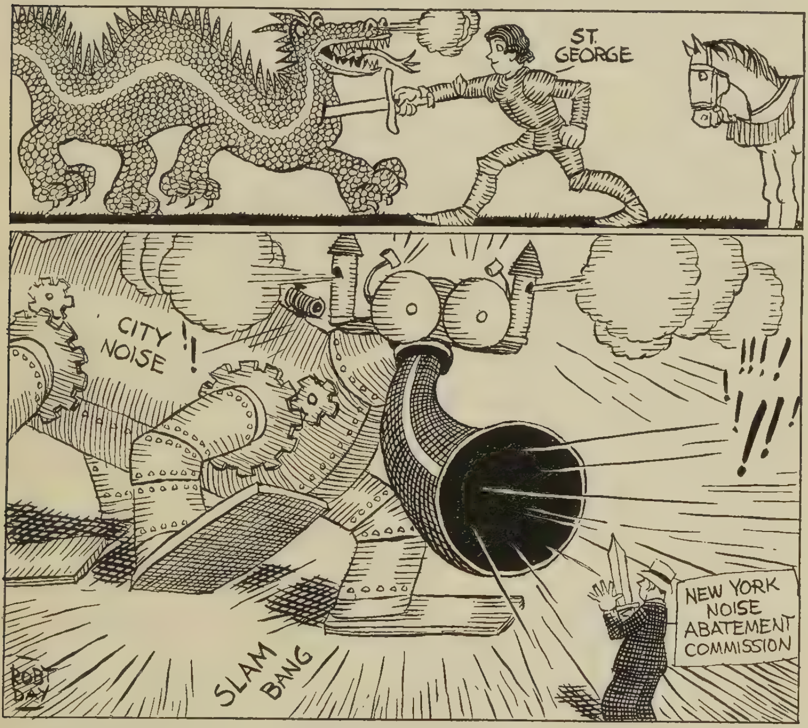
So much for the common everyday experience of all kinds of people living and working in this city! In the meantime, psychologists, neurologists, and physicians in general had been finding out some of the things noise does to us and why. Dr. Foster Kennedy told you many of these interesting facts in his talk week before last. Admitting that much research must yet be done in these fields, the facts that we now have before us show that noise is a real annoyance and a potential health disturbance for men, women, and children.

Even without the extra tax noise imposes upon us we find our lives in this modern world so complex, so speeded up that most of us have all we can do to keep up with the demands of our daily lives. As a matter of fact everyone of us has as many problems to solve, as many crises to avert each day as our ancestors had in the course of a lifetime. We could do this better if we could get rid of most of the noise of our machine-using city.

What to do about it?. . . . A mad tyrant could stop this noise in a day's time. He could order all transportation within the city stopped. He could forbid the use of musical instruments, close down theatres, prohibit people from meeting together in groups to dance and sing and be sociable. He could stop all building operations. In short, he could destroy noise by destroying the life of the city. He would very likely have to have one policeman assigned to each inhabitant in order to enforce this deadly quiet.

No. The problem cannot be solved by such despotic means. It involves everyone of the six million New Yorkers as Mr. Burlingham told you in his talk last week. It involves the very buildings in which these people live—the streets on which they travel—the machines they use in transportation—the tools they use at work. It involves the complexity of human nerves—the human requirements for rest—the need for recreation. It is a problem as many-sided as this complex city in which we live plus the six million living human organisms dwelling here.

WHAT AN EASY TIME ST. GEORGE HAD!



By Robert Day in *The New York Herald-Tribune*

In London and in Berlin, medical men have worked out elaborate suggestions for abating noise. The League of Nations has given thought to the industrial aspects of noise. In New York the course was clear. If we were to solve this noise question we had to attack it from all sides at once. Not only could medical men say that noise saps the energy and vitality of people, not only could business executives show that it keeps workers from accomplishing their best work, not only could safety engineers demonstrate that noise is an important cause of accidents, but we had to have the advice and aid of neurologists, physicians, lawyers, police executives, builders, engineers in acoustics, and in automotive design.

The Men Who Are Fighting Noise

Fortunately New York has men, leaders in these professions, who are willing to give their time and their best thought to freeing New York of the noise evil. Three months ago, when I asked these fourteen men to serve New York this way, not one of them refused. They form the Noise Abatement Commission that has put in three months of intensive work for your comfort. There is nothing honorary about their position; they are working as only men can work who know how to go after a problem and solve it practically.

People have shown such interest in what these men are doing that I feel you have a right to know them better.

Mr. Lewis H. Brown, President, Johns-Manville Corporation—an executive and organizer; Mr. Charles C. Burlingham, President of the New York Bar Association; Dr. Samuel A. Brown, Dean of New York University Medical College and Bellevue Hospital; Professor Albert H. Beyer, Columbia University, an engineer who is an expert on the New York Building Code as well as on construction problems; Dr. Alexis Carrel, whose fame is world-wide for his research work in biological and surgical problems; Dr. Arthur B. Duel, consulting aural surgeon at many of the leading metropolitan hospitals; Dr. Harvey Fletcher, Director of Acoustical Research, Bell Telephone Laboratories, author of many works on sound and hearing; Mr. Lawson Purdy, social worker and noted authority on housing problems; Dr. Foster Kennedy, in charge of the Neurological Department, Bellevue Hospital; Dr. Samuel J. Kopetzky, specialist in otology; Dr. Bernard Sachs, neurologist, author of works on the mental and nervous disorders of children and adolescents; Mr. Alfred H. Swayne, Vice-president, General Motors Corporation, representative of the automotive industry; Dr. Frederick Tilney, Professor of Neurology, College of Physicians and Surgeons, Columbia University; and the Police Commissioner of the City of New York.

To Attack Noise From All Sides

They have divided their work so that they can study the different facts entering into the problem and at the same time actual noise abatement can keep pace with the facts discovered.

One committee is studying the effects of noise on human beings, while another is planning the practical application of remedies for doing away with the noises that have been found most disturbing. In the meantime the committee on Noise Measurement is finding out just where these noises are located in the city and the committee on Building Code and Construction is working on the problems of quieter construction methods and also means of dampening sound in buildings.

In fact, New York City has turned itself into a gigantic experiment station to see if we can get rid of the tintinnabulation of civilization. Even the people who have suffered from noise are helping in this huge experiment by sending in their complaints. Already there is a map of the noises of this city made by the people, themselves. They sent in their answers to the Commission's questionnaire that appeared in the daily papers and the result is a map of New York filled with pins representing each noise. It is a very vivid picture of a condition that must be visualized to be understood. Someone once said, "If noise were like dirt and we could see it heaped up here and there, we would realize more keenly how urgent it is that we get rid of it." Well, this map shows noise just that vividly.

What noise does to human beings is known well by physicians dealing daily with their patients. And much in the last four years has been discovered by psychologists working in different research laboratories throughout the country. In addition to gathering together all this information, the subcommittee on what noise does to human beings is conducting experiments of its own, which Mr. Brown will tell you about next week in his story of what the Commission has accomplished in the last three months. Dr. Bernard Sachs, chairman of this committee, said very wisely in beginning this work, "We decided to limit our report entirely to such facts as would contribute to the early practical solution of the problem of noise abatement."

Dr. Harvey Fletcher, chairman of the committee on Noise Measurement, has already told you how his committee goes about discovering where noise is heaviest and what particular noises enter into this tremendous volume of sound that makes city life hideous.

Finding Remedies

Finding remedies for these noises is the work of another committee. Legal means, mechanical means—all must be considered. Mr. Burlingham, chairman of this group, gave you a clear idea of what it means to get six million people to stop noise.

What can be done about building without noise in the process and what can be done toward making buildings proof against noise when they are finished is the work of another committee under the chairmanship of Prof. Albin H. Beyer of Columbia University.

The work that they are now doing gives New York its rightful place of leadership. Their work will result in an intelligent noise abatement program that will be more absorbing than an H. G. Wells dream of some Utopian civilization, because it is something in which every one of us can take part—something from which we will all benefit. Next week at this time Mr. Lewis H. Brown will describe this work up to the present time.

We are all factors in one of the most extraordinary laboratory experiments that has ever been made—greater New York is the laboratory

What We Are Doing and How[1]

When Health Commissioner, Dr. Shirley W. Wynne, formed the Noise Abatement Commission, he suggested certain rather definite lines of investigation that he had reason to believe would lead to some early practical relief from this roar and clatter that is New York.

As we who constitute the Commission look back upon our first three months' work, we are conscious of two conclusions that are immediately evident. First, that Dr. Wynne had a very vivid picture of the problem and the complications involved in its solution. And secondly, that any report which we may present to the citizens of New York at this time can only be looked upon as a progress report. Our task becomes more formidable as our understanding of the problem grows.

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[1] Radio talk by Lewis H. Brown, Chairman, Noise Abatement Commission, over Station WEAF, Tuesday, January 28, 1930.

May I briefly review the suggestions tendered the Commission by Dr. Wynne?

First—What is immediately possible under existing ordinances and laws for the alleviation of the noise nuisance?

An analysis of the questionnaires printed by the daily papers and returned to the Commission's office shows that over 37 percent of the complaints concerned traffic noises. The New York Code of Ordinances already requires mufflers on motor vehicles, prohibits exhaust horns and the operation of an automobile horn for an unreasonable or unnecessary time.

There are special provisions against unnecessary noise in hospital or school streets. Two per cent of the complaints were directed against newsboys' and peddlers' cries. There are regulations governing these sources of noise. 1.4 per cent of the complaints were directed against barking dogs. There is an ordinance prohibiting the maintenance of a noisy bird or animal.

Thirteen per cent of the complaints received were about radio loudspeakers in homes and stores. There are provisions in the Code governing nuisances, and many court decisions may be cited to show that the gist of a public nuisance is to commit any act which will annoy, injure, or endanger the comfort, repose, or health of any considerable number of persons. The Court of Appeals has stated that a condition is a nuisance when it clearly appears that the enjoyment of life and property is materially lessened thereby, and the physical comfort of persons in their homes is materially interfered with.

There apparently is no question but that the Police and Health Departments and the Courts can thus effectually reduce by one-third the noises complained about. Under the present system the only way these statutes and ordinances can be enforced is by court proceedings. And who is willing to go to court and bring witnesses to prove that the noise complained of annoys, injures, or endangers the complete repose or health of a number of persons?

Seeking New Ways For Law Enforcement

The committee on Practical Remedies is working out means of easier administration for these laws and ordinances already existing. We have two patterns on which to base such simplified procedure: the system whereby a policeman serves a summons upon persons who violate the vehicle and traffic law, the Sanitary Code, and other rules and ordinances and the system initiated by Colonel Waring thirty years ago and recently used by Police Commissioner Whalen whereby a vehicle parked in violation of an ordinance can be carried off by the Police Department and held until the owner pays his set fine. The first method has two drawbacks—it requires the time of policemen to testify in court, time that could be more effectively spent elsewhere for the good of the city; and it tends to clutter up the already crowded courts. The second method is not practicable unless property can be held for the owner to redeem by payment of a fine for his offense, but, inasmuch as most annoying noises result from the use or misuse of machines, it seems adaptable to the noise emergency.

In the final analysis, noise abatement must be desired by the great majority of people if it is to be practical. Men and women throughout our city must feel strongly on the subject to make any laws or any means of enforcing these laws effective.

After all, we are dealing with a fact not a theory—an unpleasant fact too for most of us.

Second—We need a complete classification of noises; a tabulation of intensity geographically arranged; some scientific measurements of principal city noises together with specific recommendations as to their control or elimination.

This noise survey is now actively and continually in progress under the able direction of Dr. Harvey Fletcher. Considerably more work must be done before we have a complete picture of the noise of the city, and many measurements must be repeated under warm weather, open window, conditions, and at different hours of the day to provide essential data. Time, place, and conditions are all important factors.

Studying Automobile Horns

A special study is being made of automobile horns and other warning signals. First the many different types—bell-toned, trombone-like, klaxon, etc.—are being tested out by the same method street noises are being tested. Then they are to be submitted to a "jury" for the effect they have on human beings. From these findings it may be possible to evolve warning signals that will not create the disturbance that a street full of honking horns creates at present. The same sort of thing is being done to discover a policeman's whistle that will be less nerve-rending to those who have corner offices and must perforce listen to the signalling all day long.

Third—We need a scientific statement of the effect of noise on the human being.

The committee on the Effect of Noise on Human Beings, under the able leadership of Dr. Bernard Sachs, has already marshalled an imposing array of facts and reports on the psychological and physiological effects of noise. They have wisely drawn on the results already obtained in American researches, notably the work of Dr. Laird of Colgate University, Prof. Poffenberger of Columbia University, Prof. John J. B. Morgan of Northwestern University, and Prof. Dockeray of Ohio Wesleyan University. Reports of the Noise Commission of the City of London, the International Committee on Industrial Fatigue, and the opinions of leading medical authorities and neurologists have been studied with care. Dr. Foster Kennedy is at the present time carrying on a painstaking investigation of the effect of noise on brain pressure, at Bellevue Hospital. It would be impossible in such a brief discussion to even touch on the high lights embodied in their most recent progress report, but it has been shown beyond peradventure of a doubt that—1, hearing is undoubtedly affected by exposure to continuous noises—2, noise interferes seriously with the efficiency of anyone engaged in mental tasks; it affects memory and the ability to concentrate—3, in an attempt to compete with noise, great strain is put upon the nervous system leading to neurasthenic and psychasthenic states—4, noise interferes seriously with sleep, and this is of serious import in the case of

SWEPT BY OCEAN
ORIENTAL HOTEL
MANHATTAN HOTEL
SOUSAS BAND
PAINS FIREWORKS
HAGENBECK

From the collection of the New York Public Library

When buildings were lower much traffic noise escaped in the air that now is echoed and re-echoed from building to building—Fifth Avenue and 23rd Street, 1880

the sick and convalescent—5, the normal development of infants and young children is seriously interfered with by constant loud noise. The National Safety Council is gathering data to determine whether or not noise may even be a causation factor in accidents.

Fourth—We should have some scientific measurements of certain types of noises and recommendations as to what constitutes the border line of reasonable, inevitable noise and unreasonable noise.

What Makes Noise Annoying?

These investigations are in progress in several laboratories, and the results will be studied with thoroughgoing care. Enough evidence has been marshalled to indicate that there is an annoyance factor associated with noise that considers psychologically whether noise that annoys is inevitable or necessary, or whether it is the result of heedlessness, thoughtlessness, or carelessness.

Fifth—What can be done with respect to sound absorbing construction in buildings?

In buildings, a great deal—and much is being done by corporations to whom noise is costly because of lessened employee efficiency. In a smaller degree the use of sound absorbing constructions is being applied to hospitals, schools, restaurants, etc. At this time we are inclined to believe that traffic, transportation, building operation, and delivery noises, which constitute 70 per cent of the complaints received, can best be solved and will be solved at their sources rather than through absorption by the exterior finishes of buildings. The noise survey will to a certain extent answer this question.

Sixth—What experience is there in any part of the world which we may use as a basis for the elimination of unnecessary noise?

An unexpectedly large volume of data is being acquired on both the effect and means for eliminating noise. In Budapest, Berlin, London, and in several American cities a considerable amount of research has already been done. A tremendously valuable survey of New York noise, made by Dr. E. E. Free for the *Forum Magazine* several years ago, is being used not only for its conclusions but to indicate trends both in the character of the source and in location. Instead of trying to begin all over again on a clean slate, our Commission is assembling all of the available facts on the subject with the idea of proving the indictment and finding practical remedies.

Seventh—What additional laws, if any, are needed to govern the noise situation in New York?

We hope that no additional laws will be needed. We do not believe that noise can be legislated out of existence. We like Dr. Wynne's *Code of Noise Etiquette* which you have seen printed in the daily papers, and which has been given serious country wide publicity. We should like to see the mere act of creating unnecessary noise, or the intrusion of the sound of our radio, phonograph or musical instruments into the homes of our neighbors such a breach of good form and good breeding that noise will be ostracized.

We personally do not like noise, but what about you who are citizens of New York? Our Commission is groping in the dark with a stereotyped list of common noises that apparently "just happened," like "Topsy," in the presence of 3,662 people of Greater New York, which has a population of over 6,000,000 people.

In the last analysis we shall not have accomplished in the fullest sense the work that we have undertaken unless we know your individual opinions about noise. We need your opinions to direct the work of the Noise Survey Committee; to correlate the facts about intensity, pitch, and annoyance value with your opinions of what constitute annoyance values; and, above everything else, to pin to earth this elusive item which, for sake of a better name, we will call the annoyance factor of noise. We appreciate your first response, but the opinions of 6/100 of 1 percent of the inhabitants of a city of the size of New York do not provide us with conclusive evidence that we are competently examining every angle to this question. Probably our original questionnaire was too involved; the enumerated noises were too leading, and the procedure was too complicated. But may I take this opportunity to appeal to the governing officers of every civic, business, social, religious, and fraternal organization in Greater New York to ask their members at the next meeting of their organization to jot down on a plain slip of white paper the answers to these three questions—

1. What noise annoys you most?
2. When?
3. Where?

We do not need your name nor your address. You are not involving yourselves to any obligation by answering these questions. But please keep in mind that you are all factors in one of the most extraordinary laboratory experiments that has ever been made—Greater New York is the laboratory—and we earnestly solicit your cooperation.

What Can We Citizens of New York Do About Noise?[1]

MEMBERS of the Noise Abatement Commission appointed by Dr. Wynne, the Health Commissioner, are speaking on the radio in the hope that the citizens of New York may be set to thinking about noise and roused to do something about it, for it is certain that little can be accomplished by the Commission or by officials unless they are backed by the public.

One of the first things the Commission did was to invite the public to send complaints to the Commission's office. These were classified and tabulated, and it turns out that 37 per cent of the complaints relate to traffic noises, automobiles, trucks, buses, horns, cut-outs, brakes; 13 per cent to loudspeakers; 14 per cent to street cars, elevated, and subway; 10 per cent to collections and deliveries; 7 per cent to building operations, pneumatic drills, riveting, etc.

It is interesting to observe that 50 per cent of the noises complained of are easily preventable; i. e., the 37 per cent relating to automobiles, etc., and the 13 per cent relating to loudspeakers. The noises of the elevated, the subway, the street cars, and building operations are not so easy to deal with. And, further, this can be said—while the noise of the subway is deafening, we suffer from it only a few minutes each day. It is a barbarous thing to appropriate city streets for elevated railroads, but comparatively few of our 6,000,000 inhabitants live on those streets. The badly worn tracks and flat wheels of the surface roads are a trial to those whose doors the street cars pass, but they pass less frequently and comparatively few people are the sufferers. So it is with riveting and drilling—no more nerve-wracking noise can be found outside a boiler factory. But we are not subjected to these noises continuously, month in and month out, as we are to those of trucks and motors. The rock is drilled and blasted out and the foundations are laid; the rivets are driven

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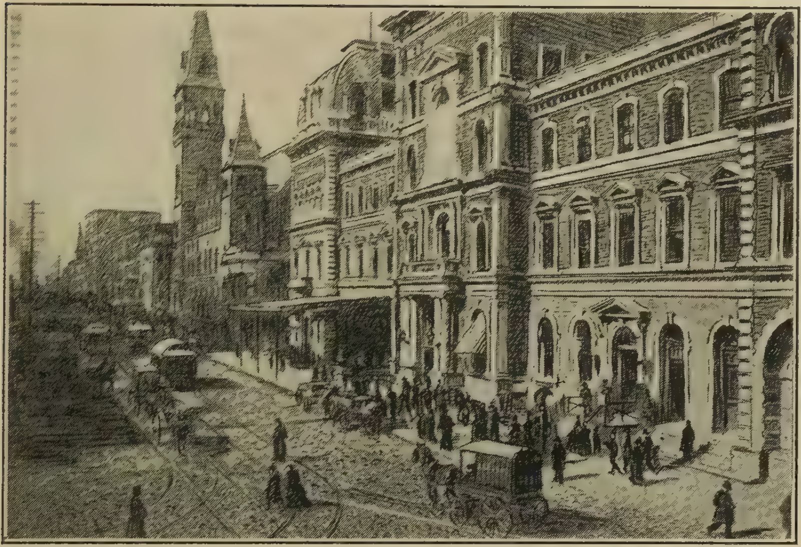
[1] Radio talk by Charles C. Burlingham, President of the Bar Association of the City of New York and a member of the Noise Abatement Commission, over Station WNYC, Thursday, February 13, 1930.



Drawing from a photograph by Brown Bros.

Grand Central Station in 1898—before the era of high buildings and imprisoned street noise

and the building is finished; then we forget our sufferings as the noise makers pass on to another street or district. But the chain-driven trucks go roaring through all our streets with the mufflers cut out; the motors blow their horns whenever and wherever they get into a traffic jam; these are permanent and continuous sources of annoyance, pain, and damage, however used to the sounds we may think we are.

Other scientific studies are being carried on by the scientific members of the Commission and their staff. The committee on remedies, of which I am a member, undertook first a thorough study of the present laws and ordinances.

Laws Already in Existence

As you know, one of the first suggestions people make when they are stirred about anything is that the Legislature pass a new law or the Board of Aldermen an ordinance. Our study soon convinced us that we have laws enough already with one or two possible exceptions, of which I will speak later. Let me tell you some of the laws now in existence: It is against the law to make an unnecessary noise in the streets—especially in hospital or school streets. Peddlers and hucksters are forbidden to cry their wares before 8 A.M. or after 9 P.M., except on Saturday nights, and they must not use a horn or other instrument or device or make any noise to disturb the peace and quiet of a neighborhood. All nails, pillars and columns of iron or steel transported in carts, drays, cars or in any other manner must be so loaded as to avoid causing loud noises. Junk men must not use a bell weighing more than six ounces nor more than three bells at any one time. Disturbing bells and gongs are forbidden on any building or premises. We are forbidden to keep an animal or a bird which disturbs the quiet and repose of our neighbors, and our children are forbidden to discharge fireworks or fire crackers without a license.

Laws Relating to Automobiles

And now as to automobiles: mufflers are required; bells or gongs like those on ambulances are forbidden; exhaust horns are prohibited. I think I will read you the exact words of the ordinance (Section 229 of the Sanitary Code):

> "Every automobile . . . shall be constructed so that the exhaust . . . is made to discharge into a muffler or other device which will prevent loud or explosive noises . . . No person having the management or control of any such automobile or vehicle, or operating the engine thereof, shall use a horn or other device for signalling except in a reasonable manner as a danger warning, nor shall any such person produce or cause, suffer or allow to be produced by means of such horn or other signalling device a sound which shall be unnecessarily loud or harsh or which shall continue for an unnecessary and unreasonable period of time."

Now, does not that seem almost enough to give us a quiet city?

We do need a new ordinance as to loudspeakers. It is a nuisance in the legal sense of the word to maintain and operate a loud speaker to the discomfort and annoyance of any considerable number of people; but to abate such a nuisance, one must go to court and prove not merely that you are yourself disturbed by the noise, but that other people also are injured or endangered in their comfort, repose, health, or safety.

We have drafted an amendment to the Sanitary Code which makes the operation of loudspeakers not merely a nuisance but a clear violation of law. We have also drawn an amendment to the Code of Ordinances which will make the operation of loudspeakers on the street or from shops illegal except under certain fixed conditions. We do not wish to stop the announcement of baseball or football games or political or other news of importance, but those horrid instruments that bellow forth on Cortlandt Street and 42nd Street must be stopped.

We have received a number of requests to restrict the use of loudspeakers in apartments, by requiring that they should be toned down, which is quite possible and that they should not be used between certain hours at night. We should like to do something of this sort, but we think it wiser to deal first with noises which affect the general public rather than with those which make the lives of private persons miserable.

Riveting

One other change in the law is under consideration. It relates to riveting. Under our Building Code there is no provision for welding, yet fusion welding is being done successfully in many cities and has proved entirely practicable. The Merchants' Association of New York is conducting a thorough, scientific study of the subject with experts of high degree, and will no doubt present a report on the subject before long.

Many of the noises from which we suffer are remediable, but improvements are costly and, in some cases, prohibitive. I am told that the roar of the subway could be overcome, but it would cost several hundred millions of dollars to do it. A diamond drill operated pneumatically makes no noise to speak of, but it is expensive. If the trucks used mufflers, as by law they

There are laws regulating hucksters' hours should, they would lose only a trifling percentage of their power. It is said that the manufacturers rather like their trucks to be noisy—it indicates power, or seems to do so.

Now to return to the law—laws do not enforce themselves. To declare by law that a continuous performance on a radio in the next apartment or a barking dog in the back yard is a nuisance does not carry us very far, for who wishes to go to court and bring witnesses to prove that the noise complained of annoys, injures, or endangers the complete repose or health of a number of persons? No, something else is required. In the first place we must make it easy to enforce the law. Under the present system the only way these statutes and ordinances can be enforced is by court proceedings. Under the Inferior Criminal Courts Act the city magistrates issue summonses in blank to members of the police force, which the policemen are authorized to fill in, countersign, and serve upon persons who violate the vehicle and traffic law, the Sanitary Code, and other rules and ordinances. This is good so far as it goes. By serving a summons instead of arresting the offender, the policeman avoids the necessity of taking his man to court, but he must go to court to testify against the offender later and he may be kept there for hours. Going to court and being a witness is one of the things the citizens of New York seem to find most objectionable. To us lawyers court is a very pleasant place to spend a few hours in, especially if we have a good client to pay us; but how often when there is an accident you see people scurrying off lest they be called as witnesses. I am afraid it is a good deal the fault of the courts themselves, for it is certainly most annoying to sit in a court house for hours and then be told to come again the following Wednesday. And this is even more serious in the case of the police, for if you stop to think of it, is there any public servant or private citizen who has more things and more kinds of things to do than a policeman? As Gilbert and Sullivan say: "Taking one consideration with another, with another, the policeman's lot is not a happy one—happy one." Commissioner Whalen tells me that every day a thousand policemen are taken from their duties as guardians of the peace to attend in magistrates' courts. What a waste of time and energy, and what a loss to the city! In London, on observing a violation of a traffic regulation a "bobby" hands a ticket to the offender, and, if the man protests, the constable says, "Sorry, sir, you'll have to settle it with the judge." If the offender fails to appear, as required by the ticket, he may find himself in serious trouble. We have here in New York a similar method which we apply in the case of an encumbrance in the city streets. It is a plan which Colonel Waring devised to get the trucks off the streets. Thirty years ago thousands of trucks were left in the streets at night and on Sunday. Colonel Waring got an ordinance through the Board of Aldermen by which he was able to carry off a truck which was left in the street and enforce the payment of a fine of $10 against the owner when he came to get his property. Commissioner Whalen has applied the same method in working out the traffic zone system in the theatre district. If a motor is parked in violation of the ordinance, it is taken away by the police and the owner has to pay to get it back. We should like to see a similar method applied to noise offenders.

A New Way to Handle Minor Offenses

We have drafted an amendment to the Greater New York Charter which would apply not only to noise but to other offenses, such as violations of sanitary regulations—spitting, e. g., and throwing litter in the streets, defective ash and garbage cans, etc. This provides that in the case of minor offenses "not involving serious danger to health, morals, safety or public welfare," the head of a department may make and publish a schedule or list of these offenses with a fixed fine for each, which shall in no case exceed $5.00, to be paid at the nearest police station house[1] by those who confess that they have violated the regulation and do not ask for a trial in court. Under this law, if, for example, a chauffeur blew his horn in a traffic jam unnecessarily, all the traffic policeman would have to do would be to hand the chauffeur a ticket directing him to appear the next morning at the precinct police station. The man goes with his ticket to the police station and presents it to the officer at the desk. If he wishes to put in a defense, then the officer would leave with him a summons to appear before a magistrate. If he acknowledges his fault, the officer should be authorized to collect a small fine as fixed by the schedule, give him a receipt, and keep a carbon duplicate. All fines collected would be accounted for to the City Chamberlain.

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[1] This method for paying the fine has been replaced in the final draft by provisions for paying at the City Chamberlain's Office.

The inconvenience to the citizen in being compelled to leave his affairs in order to go to a police station would make him see the importance of obeying the law. And all his rights would be preserved, for, if he did not plead guilty then and there, he could have his day in court at some later time, with more inconvenience to him. The same principle could be applied in the parks, which are so shockingly littered especially on Sundays and holidays. This amendment we have drawn after consultation with the Health Commissioner and the Police Commissioner, and, if we can get public support for the plan, the Municipal Assembly, which consists of the members of the Board of Estimate and the Board of Aldermen, will pass the amendment. We are confident that this simple change in the law, substituting small money payments for heavy and unenforceable penalties as for a misdemeanor and relieving the police and sanitary inspectors from attending court in 99 cases out of a 100, will recommend itself to the people of New York and will help to solve many troublesome problems of administration.

New Yorkers' Aid Needed for Results

But all these suggestions and plans will come to naught unless the people of New York seriously and vigorously back them. Do they really wish to have a quiet city? It is unnecessary to tell an American audience that it is not enough to have a law on the statute books—we must have public opinion behind the law if we wish it enforced. If you could answer back on the radio, I think I should be deafened by the roar of one word—PROHIBITION. The truth is we sometimes have too much law, or rather laws carrying too severe penalties. The other morning in the elevated I read this sign:

> "Spitting on the floor of this car is a misdemeanor. $500 fine or imprisonment, or both, may be the punishment therefor. Section 124, Sanitary Code, Section 15, Penal Code. By order of the Board of Health."

Now, of course, no one ever was or could be fined in this city $500 for spitting, obnoxious as the habit is; but the very fact that that $500 is mentioned makes the law seem ridiculous. The same penalty applies to littering the parks. A fine of 25 cents for throwing a newspaper on a lawn would be more effective in cleaning up parks than a threat of a $500 fine or imprisonment or both.

The change in respect to spitting is the result not of law, but of the gradual development of public opinion. I think the time has come for the manager of the elevated to take down the sign in the older cars which I blushed to find in one of them the other day—"Do not expectorate from the windows of this car."

If the citizens of New York really wish to do away with unnecessary noise and to reduce to a minimum such noises as are necessary, they can accomplish it if they are willing to take a little trouble. They cannot take the law into their own hands; they must act for the most part through the police. If they are vigilant and have the courage to speak to the offenders and threaten them with an appeal to the police or the law, and will do their part in helping the officers of the law, they will be surprised to see how rapidly things will improve. It is all a question of public opinion. If that is once aroused we can enforce the laws we have and, if we need others, obtain them.

NOISE ABATEMENT COMMISSION
DEPT. OF HEALTH-CITY OF NEW YORK

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Noise[1]

THE FORUM'S SECOND REPORT ON CITY NOISE

E. E. Free, Ph.D.

Two years ago Dr. Free, then the Science Editor of The Forum, conducted under its auspices the first scientific study of city noise. The influence of this article spread—very much like the sound waves which he describes; and in the present article he describes the results. We are progressing toward the noiseless city of the future. Dr. Free's Forum Noise Code is the first comprehensive plan for the legal elimination of needless uproar. He also shows how the harassed city-dweller may spare his nerves.

IN TWO years there has been much noise about noise and by no means all of it has been conversation. Things begin to get done. It is already evident, for one thing, that no city need put up with its present clamor if the citizens really want a change. A completely noiseless town is probably no more possible than a completely spotless one, but few people would enjoy living in such extremes of perfection. And relative noiselessness of cities is as possible and far less costly than the relative cleanliness which we have learned to demand. Even now a family can have a quiet house within a hundred yards of the noisiest street corner in New York City and it will cost no more to build it than an ordinary noisy house will cost.

The only real obstacle to quiet lives is an imaginary one. We think them impossible. In a decade or two, when another thought shall have come to us, it may be considered as clear a sign of bad municipal housekeeping to permit noisy streets as it is now to get along without sewers. Landlords who build or maintain dwellings that admit too much noise may then be held as much at fault as those who now allow the roofs to leak or gas to seep into the basement. Noise, indeed, is even easier to keep out of a properly built house than rain or sewer gas. Just as soon as enough people demand quiet they can have it.

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[1] From *Forum* of March 1928, with permission of author and publisher.

In February, 1926, when *The Forum* published its now famous noise survey of New York City—the first attempt, I believe, to obtain really accurate information about just how noisy a modern city is—there were three problems of city noise for which no one had answers. First was the quantitative problem of where, when, and how much. What are the actual amounts of noise, measured by dependable scientific instruments, in different parts of a modern city at different hours of the twenty-four? Second was the problem of noise sources. Which of our modern mechanical slaves make the greatest outcry as they do their work? The third was a psychological problem. What actual damage, if any, does noise do to the average human being?

Thanks to numerous investigations which the *Forum* survey probably may take credit for inspiring, the first two of these problems have been solved. The blanket of noise that covers a modern city has been weighed and measured. A noise map of virtually any city may now be drawn from only a few actual measurements; it is almost identical, in fact, with a map of the traffic on the streets. We now know, also, approximately how much of a city's noise comes from specified sources: from automobiles, street cars, riveters, and the rest. Knowledge of this physical side of the problem of city noise has made more progress in the past two years than in all the previous history of acoustic science—a fact in which the Editors and readers of *The Forum* may take a proper pride.

When the *Forum* survey was made, this physical side of the problem seemed by far the larger one. Now that it is solved the emphasis is reversed; the pressing uncertainties are now the psychological ones. It is evident that noise in itself is not especially harmful, for even the most nervous individuals often enjoy noises that they themselves make, from tapping their feet on the floor at a concert to tooting their automobile horns at every corner. It is always the other fellow who is annoyed. That the annoyance is real enough there can be no question nor does any psychologist who has studied noise imply that noises ought not to be stopped whenever possible. The uncertainties arise in deciding just which noises should be stopped first, which are most annoying and most harmful to average people. Is the single rooster who wakes up the city visitors in the country more of a menace to peace and comfort, or is it the continual deep-toned roar with which the city keeps awake its country cousins but lulls its own sons and daughters to rest?

Fortunately these problems of noise psychology have now been taken for their own by the most active of the antinoise organizations now at work in the world, the Committee on the Elimination of Harmful Noise, of the National Safety Council of the United States. Thanks to the programme of psychological studies proposed by the Chairman of this Committee, Dr. H. Clyde Snook of New York City, in his last report to the Safety Council, we may expect some day to know just which kinds of noise are the most important to kill, as well as something about how to kill them.

Soon after the *Forum* survey of New York City, a similar noise survey of the Loop District of Chicago was made by Mr. J. F. Norris of the Burgess Laboratories. A partial survey of Washington, D. C., was made by representatives of the Graybar Electric Company, using apparatus and methods identical with those of the *Forum* survey. Isolated noise measurements have been made in Boston, in St. Louis, at Niagara Falls, and elsewhere. The New York survey has been extended by my own staff to the upper floors of high buildings, to the subways, to parts of Brooklyn, and to a few points in the Metropolitan suburbs. Public agitation about noise, accompanied by a modicum of actual measurement, has been noted in London, Paris, Berlin, and other world capitals. The snowball of public interest which *The Forum's* tests began is still rolling.

The facts thus learned about the when, where, and how much of city noise are easily summarized. The great noise-maker, as *The Forum's* first survey disclosed, is the traffic on the streets. Noise begins in the morning when the traffic does; during the day it ebbs and flows exactly as does the stream of vehicles using the streets. Streets that carry dense traffic also broadcast much noise. The corner of Thirty-fourth Street and Sixth Avenue in New York City, a location cursed with three main streams of street traffic, three surface car lines, and two tracks of the Elevated Railway, still holds the palm as the noisiest normal street corner found in any city, the word "normal" being intended to exclude roofed-over places with exceptional reverberation and a few other instances of similar rarity.

Another general fact about street noise is that it spreads little from its birthplace. There are interiors of blocks in New York City that are as quiet as the average country town, although the four streets that surround these oases may be among the city's noisiest. The sound waves generated in such plenitude on these streets are absorbed and reflected upward by the house fronts. Back yards may be actually shaded from the street noise as they would be from the sun.

As one ascends floor by floor in the high skyscrapers of New York and Chicago, the noise entering the windows decreases little for the first eight or ten floors. Tall buildings standing alone are more fortunate but such are rare nowadays and if tall structures line both sides of a street the street noise echoes upward with little diminution for perhaps as much as the first dozen floors. Between the tenth and twelfth floor and about the twentieth or twenty-fifth the street noise gradually dies away. At the same time, in New York, there becomes evident another noise which is negligible on the street level, the noise of the whistles of tugboats and other vessels in the harbor.

Once, it is reported, this harbor noise was the most distressing in all New York. That it is less so now is due to two things. By an agitation some years ago, headed by Mrs. Isaac L. Rice, the tooting of the tugboats was somewhat diminished, and this habit of reasonably quiet operation seems to have persisted among the captains of the river craft. At the same time New York has built its great walls of skyscrapers, shielding the streets of the downtown city from the river noise much as lesser buildings shield the city's back yards. Nowadays river noise is negligible in New York City's problem. Only in water-front districts or on the upper floors of high buildings do the toots of the tugboats reach the ear at all.

The numerical "noise units" of the actual surveys mean little except to the acoustic expert. It is more useful to say that the average street noise of a normal busy street in New York or Chicago makes the ordinary individual about one-third deaf. The noisiest streets may make him half-deaf or even two-thirds so. Night noises, which many people find the most annoying of all the city's assaults on the ear, are seldom louder than the equivalent of one-tenth deafness. More often the night noises total less than half as much. Which is another evidence that the psychological effects of noise are not determined exclusively by intensity.

Among noise-making devices, a good word must be said for one commonly imagined to be the archdevil of them all, the riveting hammer used in the construction of steel buildings. Here enters another curious psychological problem, for the annoyance caused by these hammers to most individuals is altogether out of proportion to the physical intensity of their noise. Within distances of fifteen or twenty feet the noise emitted by these devices is intense, but to no one except the machine's own trainers and attendants is apt to get so near to it as that. As measured under ordinary conditions on the street level, the noise due to these machines is almost always less than the noise of traffic on a busy street itself.

One possible explanation of why it seems so much louder than this is that the noise of the riveter is added to the noise from other sources, making the sum unbearable; for it is one of the physical properties of noise that two separate noises reinforce each other in the ear, like adding weights. It is true that on a street already noisy a riveter may increase the noise considerably; but it is not under these circumstances, curiously enough, that the chief complaints against riveters are made. Objections far more numerous and distracted come from residents on quiet streets made temporarily noisy by building, but made far less so, in any instance that we have measured, than the normal condition of busy streets on which the same complainants experience little discomfort.

The most probable explanation of the extraordinary annoyance created by riveter noise is its intermittence. The ear has no chance to protect itself by forming a habit. Into the midst of comparative silence bursts the sudden rat-tat-tat like the explosions of a machine gun. Explanations why this is so annoying trespass on the field of the noise psychologist, a field yet little tilled, but it might be worth while to consider whether riveting might not actually be less annoying if it were louder but more continuous, the machine emitting its same series of staccato barks when it is not driving a rivet as when it does. That would give the ear a chance to get used to it, as the ears of locomotive engineers get used to the noise of the train.

Data now accumulated for New York City are sufficient to make some general apportionment of blame for that city's noises. The one great noise-maker, there can be no doubt whatsoever, is the automobile truck. This ubiquitous vehicle accounts for at least forty per cent of the noise at an average noisy corner in New York. Another twenty-five per cent of the noise at such a corner is produced by the Elevated Railway, an affliction which most other cities have escaped. Surface street cars account for about another twenty per cent of the noise, there being special reasons, not unconnected with the political retention of the five cent fare, why neither the street cars of New York City nor the cars of its Elevated Railway system can be kept in as good and noiseless condition as modern engineering practice would suggest.

This leaves only fifteen per cent of New York City's noise to be supplied by all the other noise-making trappings of civilization: by private automobiles and their too-easily-tooted horns, by taxicabs, by horse-drawn vehicles of various kinds, by the spectacularly noisy fire apparatus and police patrols and ambulances, by the whistles of the traffic policemen (an item by no means negligible in the annoyance it may create), by building and excavating operations, by railway engines in the city's fringes or tugboats on its rivers, and by all the rest. Indeed, fifteen per cent is probably somewhat too much to allow for all these noise-makers in the average city. Ten per cent might be truer, especially for cities which are not dug up and reconstructed quite so continually as has become the habit in New York.

This seems to me the most important practical fact uncovered so far by the whole investigation of city noise. Eighty-five or ninety per cent of the noise of cities comes from electric traction and from automobile trucks. If this noise could be eliminated, New York would be quieter than it has been in a century, for it is a mistake to imagine that the city of a generation ago was importantly quieter, except perhaps at night, than it is today. Horse-drawn drays rattling over the cobblestone pavements then in vogue made even more noise than the noisiest automobile trucks make on the smoother roadways of the present.

The practical problem, not only for New York but for every city or town where noise has become any annoyance, is whether these two great sources of noise *can* be eliminated. Trucks and street cars cannot be forbidden the streets; they are servants far too useful for that. Perhaps they can be made less noisy?

There is no doubt of an affirmative answer. Indeed, the elimination of most of the noise now emitted by trucks and street cars is absurdly easy. It would even pay in dollars and cents. The secret is to keep the vehicles in perfect condition. Proper daily inspection, repairs and service for every bus, truck, or street car permitted to use the streets would cut city noise in half in a week. There is ample engineering experience to prove that it would save greater repairs later on and would lengthen the lives of the vehicles. There is scarcely any doubt that savings would more than equal the cost, noise being left entirely out of account.

In any kind of moving machinery there are two chief noise-makers. One is the pounding of metal parts against each other, like the tapping of the valves of an automobile engine or the grinding of the gears. The other is something loose that rattles. Both do harm—mechanically as well as to the listener's ear. The best gears are so designed and oiled that they make little noise, with correspondingly little wear. Loose boards, gear cases, metal sides, and the like should be bolted down tight before they shake themselves loose altogether. With street cars another item of careless practice that creates much noise is the presence of bad crossings, gaps, or loose joints in the rails. All these things are bad engineering anyway. Taken together they create more city noise than everything else combined.

Tests have shown a loose, badly serviced truck emitting nearly five times the noise of a well conditioned example of the same make and size. The bad record of trucks as noise-makers is more the fault of owners and drivers than of makers. One of the large truck manufacturers, by the way, has recently begun acoustic research to lessen still further the relatively little noise which the new and perfectly adjusted vehicle emits.

It is quite within the power of any community to force proper service on the owners of trucks, street cars, and other vehicles that use the streets. Public inspection of automobile brakes, lights, and other devices for safety is now a common rule. Although sometimes resented, such inspection has proved beneficial to everybody, even I imagine, to most of the resentful owners. Is such enforced inspection of vehicles for noisiness something that we noise-haters are entitled to ask?

It would be, I am sure, if we could be certain that city noise does as much harm as most people believe. Again we are face to face with the psychological problem into which the whole inquiry into city noise seems to be resolving itself. Mere annoyance is not necessarily harmful, as was pointed out by no less an authority than David Harum in his famous remark about the value of a few fleas on a dog. As Dr. Snook put the matter in his report last September to the National Safety Council, "There is no doubt that noise is disagreeable to great numbers of people, who want it eliminated; but there certainly is not enough scientific information to permit reliable estimates of its harmfulness or of the money value of its economic waste for any group of people." Published estimates purporting to give the "cost" of noise to this city or to that are mere space-filling words.

Nobody knows what noise costs and nobody is going to discover except by some more hard scientific work. Preliminary experiments by Dr. John J. B. Morgan, of Northwestern University show, Dr. Snook reported, that noise seems to have effects on such purely bodily matters as the heartbeat. These experiments the Committee hopes to follow up and extend.

Meanwhile, the hater of noise has two resorts. He can build himself a noiseless house or he can persuade his community that the case against noise is already strong enough to warrant its suppression. To noise-proof a house already built is not cheap, but even this is possible. If a new house is being designed a little advice to the architect from an expert in modern acoustics will provide a relatively noise-proof structure with little or no increase of cost. Most of the noise enters ordinary houses through the windows and noise-proof windows are not especially difficult to contrive.

For communities, let us offer the *Forum* Noise Code. Bare of the verbal decorations which lawyers will know how to add, its regulations would run thus:

> 1. The owner of any automobile truck, street car, or other vehicle found, on inspection, to be emitting unnecessary noise because of loose parts or bad adjustment shall be subject to heavy fine.
>
> 2. Loose joints in street rails, wide gaps at rail crossings, or other noise-producing breaks in the rails are prohibited.
>
> 3. No automobile horn or other warning signal shall be blown on streets equipped with traffic lights or provided with traffic officers (horn signals being then totally unnecessary) and horn signals in other locations shall be limited to a single sound lasting not over one second.

All three of these rules are practicable and enforceable. In any ordinary city they will reduce noise at least fifty per cent. Now we shall see how many communities really want to be quiet.

The Plague of Noise—A Blot on Our Civilization[1]

Professor Henry J. Spooner

(*Member of the International Fatigue Committee of the American Society of Industrial Engineers, and Pioneer of the Noise Abatement Movement.*)

AS I understand it, civilisation connotes the possession of such a settled system of wise law and government as enables people to live healthfully and happily in organised communities. The dwelling providing a rough measure of the degree of civilisation a people has attained. In a word, the health and happiness of a community are a fair measure of its civilisation. Thus anything that impairs the health of the people, the most vital national asset, or is detrimental to their comfort and well-being has a destructive effect on civilisation.

The teaching of history is that civilisation is gradually developed in the course of ages by enlargement and increased precision of knowledge, inventions and improvements of arts, and the progression of social and political habits and institutions towards general well-being. But, alas! every development of civilisation which confers a benefit also creates a nuisance in some form or other. Thus the age of steam created the smoke nuisance. Oil burning vessels have created the nuisance of oil on the waters, so destructive of bird life, and so unpleasant to those who go to the seaside in summer time. And the remarkable development of mechanical road traffic and transport, that has brought so much pleasure into the lives of countless people, and has so greatly facilitated the carriage of goods throughout the country is, as we too well know, the cause of the most terrible wastage of civilian human life the world has ever seen.

Strangely enough, some centuries before the Christian era, the cultured Greeks of Sybaris gave some attention to the noise question. Sybaris in Southern Italy was the oldest Greek colony in this region; it was founded in 720 B. C. and became great and opulent, and also efficient, as this magnificent and luxurious city had regulations prohibiting industrial noises in residential areas, and providing for the zoning of the city. The Romans, who were in some respects barbarous at that time, sneered at these sensible regulations as signs of effeminacy and invented the yarn about a Sybarite who could not sleep because a leaf was crumpled in his bed of rose leaves.

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[1] *The Guildhouse Monthly,* London, November 1929, with permission of author and publisher.

In more recent times, noise has been the cause of much mental distress; Carlyle dreaded the sound of a cock-crow, and had a sound-proof room made to work in. Schopenhauer, the famous German philosopher, was tortured by the crack of a carter's whip, and believed that "noise is the true murderer of thought." Herbert Spencer, the great thinker, was so much affected by noise, that he used to plug his ears with wool. He often said that "you might gauge a man's intellectual capacity by the degree of his intolerance of unnecessary noises."

"Hold your tongue," said a Frenchman, "you talk so much that I cannot taste my meat." The Frenchman was right, as any student of the organs of sense is aware: the explanation being that the mind cannot well attend to two or more sensations at the same time.

We have all suffered agonies when near the garrulous who talk in loud voices and gabble continuously. "Doctor," said a sinner of this type, "I want you to prescribe for me." "There is nothing the matter, madam," said the doctor, after feeling her pulse; "you only need rest." "Now, doctor, just look at my tongue," she persisted, "what does that need?" "That needs rest too," replied the doctor.

We must have all noticed how disturbing to the worker and sleeper are intermittent noises. And I might explain that my sincere, deep and lasting interest in the prevention, elimination or reduction of unnecessary noise was first aroused by some very pathetic cases of nervous breakdown that came under my notice whilst I was professionally engaged on industrial noise problems many years ago. Had I not witnessed day by day and month by month the almost paralyzing effects of intermittent nerve-shattering din on men who were physically strong, I could not have believed it possible.

Most people claim that they get used to noise, and that therefore it does not affect them, but this is a *fallacy,* as the primary reason why hideous noises are so complacently tolerated is that sound always in the ear is hardly heard; as it is a law of nervous stimulation that a continued activity of any animal structure results in less and less psychic result, and that when a stimulus is always at work it ceases in time to have any appreciable effect. Thus a constant noise, as of the sea waves, or of some kinds of street traffic, may cease to produce any conscious sensation; and this explains why a harmful noise may be mistaken for comparative silence—an *illusion* that is far too prevalent. Hence the danger to public health, as although noise may not be heard, the nerve-force suffers; the power of the nerve-pores and corpuscles being affected by the stimulation until it declines by exhaustion. Thus does physiology explain the *paradox;* but at the same time it points out the *fallacy* of supposing that noise can be harmless because we get accustomed to it; or that the nerves are adapting themselves to the multitude of strains imposed upon them.

Another *common fallacy,* that is frequently put forward by writers who are ignorant of what can be done by engineers in the reduction of traffic noise and in the quietening of industrial machinery and processes, is to state that as we cannot get rid of such noise, we might as well learn to enjoy it.

One of the most serious aspects of the noise problem, is that of sleep; particularly in cases where mental workers and invalids are concerned. Normally about a third part of our lives is given up to sleep, that "sweet restorer of tired nature." Now science tells us that those who think most and do most mental work require most sleep, and that if the recuperation does not equal the expenditure of the brain's energies, that organ withers, causing insanity. The ancient torturers well knew that persons prevented from sleeping always died raving maniacs; and the Chinese torture of the noise, and the inquisition sleep prevention, were based upon this fact. Countless people living near late-traffic noises are deprived of sufficient sleep, and thereby injured in health, even when the bedroom windows are closed to keep out the din. But the danger to health and life is greatly increased in the cases of invalids who are deprived of that vital balmy repose; "life's nurse, sent from heaven to create us anew, day by day."

In considering the question of traffic noises, it must not be overlooked that many night-workers suffer very much through their inability to get during the day undisturbed sleep—"soundless as the chariots on the snow," to enable them to recuperate.

How wonderful and impressive silence can be, we realise year by year when for two awe-inspiring minutes we reverently bow the head, and share in the grief and homage that knit the hearts of the community, and vivify the lasting remembrance of our glorious heroes.

Happily, we have some appreciation of the value of silence, as there are places where the public does impose quietness upon itself, thus demonstrating the need of golden silence as an aid to thought and concentration. For we may not talk audibly in public libraries, reading rooms and the like. And I have found in some Continental hotels notices attached to the walls of corridors, requesting visitors to preserve silence between the hours of 8:30 P.M. and 7:30 A.M.

The articles and letters which almost daily appear in the Press of the world, and the countless letters I have received relating to the noise nuisance, are doubtless written by members of that relatively small minority who have to think and therefore often suffer agonies when doing their brain-work amidst distracting noises. But I am afraid we must assume that the majority of people rather like noise, or certainly do not trouble about it; indeed, we know that there are some who actually like all sorts of noises mixed indiscriminately together. We know that children love noise; and it has been said, so do the half educated, and also some types of the insane. Thus we see how the vast majority, who are not conscious of the injury being done to them by noise, must be protected from harmful preventable din by the Authorities responsible for the health of the community.

In all civilised countries man has too long suffered from the tyranny of preventable noise, and nothing short of rebellion against it is likely to ameliorate his lot. At the same time we must all have noticed in some towns an astonishing reduction in the amount of hideous noises from the exhausts of motorcycles, and in the use of ear-splitting hooters by their drivers, since the Home Secretary tightened up the law against them. We may sincerely hope that this success will encourage the Authorities to promulgate further beneficent enactments.

As an example of our lethargy in matters relating to the health of our workers and others, I find that during the War I attempted to state the case for noise reduction in an article entitled 'Some Aspects of Industrial Fatigue,' which I wrote by request for Cassier's *Engineering Monthly,* and I will venture to quote the following brief extract:—

> "Little appears to have been done by investigators in this particular branch of fatigue work, but it is safe to suggest that any efforts made in industrial works (indeed, in any place where work is done) to reduce the amount of noise and to make the atmosphere in which workers toil as restful as possible, would lead to increased production, and an improvement in the general condition of the workers, particularly in their nervous systems. Some engineers know by experience and introspection how much we are affected by noise, and how a period spent in the midst of working machines and mechanical operations—causing strident and deafening sounds of a wide range, and shocks to the auditory nerves, produces a feeling of sensory fatigue, and that although this fatigue affects primarily a single organ, it little by little extends to the whole of the nervous system; leading in some cases to such a feeling of weariness that it may impair the capacity for work in a greater degree than severe muscular fatigue. Further, deafening sounds, such as those of a boiler shop, affect the acuteness of hearing; indeed, may cause deafness itself, or a perforation of the membrana tympani."

In preparing my last paper on the Noise Question for the American International Committee on Industrial Fatigue (which was read in Chicago on May 25, 1927) I carefully surveyed the whole field representing our noise problems, and I will venture to give you very briefly my considered opinions on them:—

1. The fatiguing and injurious effects of noise in all our activities is the most neglected aspect of the science of Hygiene and of Fatigue.

2. The prevention or reduction of noise in commercial and industrial work is a paying proposition.

3. That mental work done in a noisy distracting atmosphere sooner or later leads to nervous complaints, and tends to lower efficiency and output.

4. There is a growing revolt in all civilised countries against the tyranny of noise in the streets in the work place and in the home.

5. That the mechanical uproar of tramway cars is the most nerve-shattering noise in our streets.

6. That our buses come next to the trams as harmful noise makers; particularly on hills, and when rapidly accelerating on low worn gears. There are no engineering difficulties in making these vehicles practically noiseless in running, as they should be.

7. Tube railways are notorious for their distressing, injurious din and vibrations; indeed it is a wonder that their present condition is so patiently tolerated. The primary causes of the trouble most sooner or later be tackled; it is little use tinkering with the secondary ones.

8. That worn ramshackle noisy motor vehicles should be warned off the streets by the Authorities, to be reconditioned or scrapped. This policy would also be in the true spirit of economy.

9. That horns or hooters should be standardised as to pitch; and that a low melodious note should be adopted; that driving-on-the-hoot should be prohibited; and that Klaxtons and the like, should only be used in cases of emergency.

10. That the use of the harmful nerve-racking rock-drills, for breaking up roads, &c., should not be permitted in the streets of towns; certainly not in the vicinity of hospitals, nursing homes and schools. And that the injurious effects of the intense vibrations on the spinal cord of the road driller, and the like, calls for serious attention and investigation.

11. That noisy machinery means abnormal wear and waste of power. The noise also tending to reduce the productive powers of the workers; and it may, through nervous action, be a possible

cause of accidents. In short, noise is one of the heaviest overhead costs in modern business.

12. Designers and constructors of machinery must pay more attention to the balancing of rotating parts, particularly high speed ones, and to the mounting of certain machinery on anti-vibration supports. There is wide scope for genius in dealing with noisy processes.

13. That the noisy surroundings of countless hospitals, nursing homes, colleges and schools is a serious matter calling for earnest attention.

14. That the alarming depreciation in the value of house property and land on or near the hundreds of miles of noisy main traffic routes in this country must amount to an appalling figure.

15. That the most serious aspect of the noise problem, one that has received no attention, is the enormous loss due to impairment of working capacity and efficiency in city and industrial life; more particularly as to men of affairs, principals and executives, whose capacity for clear thinking, hard work, and energetic action is, without doubt, perceptibly weakened by the incessant if unconscious strain upon their nervous systems caused by the din of typewriters and adding machines, and by the babel of noise penetrating their offices from outside. In the aggregate, the economic loss due to this kind of wastage must be staggering in amount; indeed, it could conceivably be a great deal over a £1,000,000 a week, in Great Britain alone. But the loss due to ill-health and premature death cannot possibly be estimated.

Too often when official action has been called for in connection with noise as a nuisance, the question of a standard of noise has been raised; but, as I have often explained, you can no more have this than a standard of offensive odours. As long ago as November 25, 1906, I was interviewed by *The Observer* on this question, in connection with the licensing of motor omnibuses, and I explained the difficulties my dear friend, David E. Hughes, the immortal discoverer and inventor of the microphone, experienced when he was called upon to devise an instrument which would make audible the beatings of the heart, and how this instrument also gave forth the noises due to the action of almost every other organ of the body, with chaotic results.

It is a strange fact that although most people are careful to conserve their eyesight, they do not seem to worry when their other pre-eminent intellectual sense, hearing, is affected by noises they dislike; but he who understands the working of the aural organ, the most wonderful and most exquisite piece of mechanism in the human body, is ever careful to protect this gateway to the mind and soul; through which our feelings are exalted or tortured. And when I think of the marvellous ingenuity evinced in the design of the ear, I bow my head in profound reverence to the Power, Wisdom and Goodness of God, as manifested in the creation of it.

But how strange and puzzling it is to one, that the noble medical profession refrained so long from taking an active part in the movement against preventable harmful noise. As recently as October, 1927, one of our most distinguished medical men concluded a charming letter to me with the words: "How has this subject been neglected so long by my own profession." However, happily since that time history has been made, as through the beneficent activities of Dr. T. G. Nasmyth (the famous authority on medicine and hygiene) the Edinburgh and Leith Division of the British Medical Association tabled a resolution for the Agenda of the B.M.A., July 1928, meeting at Cardiff; and after this resolution was unanimously passed, questions were asked in Parliament, and the Noise Question commenced to receive serious attention from the Authorities. And early this year the International Labour Office of the League of Nations published an important brochure on Noises, which I had the honour of reviewing in *The Times* of February 12. But the most notable event was the reception by the Minister of Health of a Deputation from the Medical and Science Councils of the People's League of Health, on December 4, 1928; and I will venture, in concluding, to read some brief extracts of the important speeches made on that occasion by some of the greatest living authorities on neurology, mental diseases, and the like.

SIR THOMAS J. HORDER, Bart., M.D., &c., who introduced the Deputation, said that "eminent neurologists and mental experts have emphasised the grave effect on the nervous system of noises which tend to increase the incidence of functional mental and nervous disorders in our midst."

SIR ROBERT ARMSTRONG-JONES, C.B.E., M.D., D.Sc., &c., said "The ordinary worker, if he is to support himself and his family and to carry on, has a pre-arranged and proper setting for his period of rest, and his life is of necessity one of routine. He goes to bed tired and exhausted, but he is repeatedly roused, and his sleep disturbed by loud and most distressing noises. He rises in the morning shaky, confused, and unrefreshed after his so-called "night's rest." His health suffers, his work deteriorates and he eventually joins the highly sensitive neurasthenic, who jumps even when the clock strikes, and he may in consequence of loss of sleep end his life in the asylum; or he may try to get sleep from drugs and so become an 'addict' to sedatives or to drink. In any case unless he can secure natural sleep his health is ruined. Men and women are not the only sufferers. The general health of children becomes affected from loss of sleep. Their development is impeded and their growth is retarded from this cause which is preventable. As a consequence they become inattentive mentally, they show restlessness and the question of the lack of proper sleep for children has been specially referred to this year in the Report of the Medical Officer to the L.C.C."

PROFESSOR GEORGE ROBERTSON, M.D., &c. (Professor of Psychiatry) said, "The effect of noise, especially prolonged noise, on the nervous system may be in the nature of a constant strain and drain on nervous energy and this may lead ultimately to exhaustion. It is this action of noise, causing nervous and mental exhaustion, that leads to neurasthenia. This seems to be a much more common disease now than formerly. . . . The consequence of neurasthenia, apart from the misery it entails, is a loss of national efficiency, which is an important matter in these days of struggle and competition. . . . It is alleged that loss of sleep occurs either as a cause of a symptom of mental breakdown in about 75 per cent of the cases. . . . Undoubtedly loss of sleep is one of the causes of insanity—and the production of sleep one of the means by which insanity is prevented and also cured."

SIR MAURICE CRAIG, C.B.E., &c. (Consulting Neurologist to the Ministry of Pensions, &c.) said: "As sleep, and sound sleep, is a fundamental necessity for mental health, it is evident how important becomes the question of disturbing noises. When exposed to these, the auditory centres in the brain can never be at rest and nerve fatigue results with all its concomitant symptoms. Disturbed nights are injurious enough, but persons are also exposed by day to much noise which in its origin thoughtless and unnecessary. Over-stimulation of the nervous system is one of the most important factors in bringing about minor and at times major mental disorder, and noise is an important factor in producing this over-stimulation."

DR. MATHEW B. RAY, D.S.O., said: "Everyone recognises the difference in the mentality between children reared in quiet, peaceful surroundings and those who, through force of circumstances, are brought up amidst the roar and din of traffic. In the latter case, the noise penetrates not only the nurseries and sleeping apartments, but is continuously present in class rooms where teaching is going on. The perpetual over-stimulation of the auditory nerves and through them the higher centres of the brain by these discordant sounds, has a most deleterious effect on the power of concentration and eventually produces varying degrees on mental irritability and instability."

DR. THOMAS BEATON, O.B.E. (Medical Superintendent of Portsmouth Hospital) said: "The constant stimulation of the central nervous system through the organs of hearing constitutes a continuous drain upon the nervous and mental energies of the individual and undoubtedly constitutes one of the major precipitating causes leading to the final breakdown. . . . On the January 1, 1928, the number of notified insane persons under care in England and Wales was 138,293, this giving a proportion of one in every 275. . . . At least 1 per cent of the population is rendered ineffective by reason of nervous or mental disturbance, and this may serve to estimate the necessity for reducing one of the more important causes for such disabilities, namely, noise."

SIR THOMAS OLIVER, M.D., &c. (Professor of Medicine) said: "The noise created by hammering rivets into steel plates is harsh, and as many men are working close to each other the clang is almost continuous. The percentage of men who have followed the occupation for 15-20 years without becoming deaf is small. Men who have thus lost their hearing are badly fitted for other occupations. The deafness causes the men to be introspective, and, in the case of illness, tends to delay recovery. . . . Inside some factories the noise is so deafening that as many of us know it is impossible to hear what is said by friends standing close to us. Upon people highly strung and of a sensitive nature the constant noise must be nerve-racking, also a cause of headache, and of irritability and instability of the nerve centres."

MR. E. B. TURNER, F.R.C.S., said: "Many years ago the bars in the South Paddington residential district were removed, thus permitting a great volume of horsed goods and other traffic from the Great Western station to proceed at all hours of the day and night through the quiet squares and streets of that district. From being an exceedingly healthy set of individuals, the people in that neighbourhood developed numerous cases of ill-health. A distinct depression in health among the people that I looked after in these districts was immediately noticeable."

Ladies and gentlemen, you have heard what can be said about the most insidious and harmful plague that has ever afflicted the human race, and from my heart, I appeal to you for your earnest aid in combatting this grave menace to the World's Health, in the sacred cause of humanity.

The Measurement of the Effects of Noise on Working Efficiency[1]

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Introduction

Aural disorders have been attributed in some instances to exposure to continued noises of high intensity. It has long been recognized that quiet conditions are important for hospital patients, partly because of their apparent effects on the convalescent period, and partly because they remove irritating stimuli from those who have been made especially irascible by physical ailments.

Just what effects the increasing noises of our modern machine civilization have on the workers in the normal course of the day's work has been largely a matter of conjecture. If one were to reason from observations such as those in the foregoing paragraph, the conclusion would be reached that industrial noises not severe enough to cause aural disorders would probably still show an ill effect on the working efficiency of those exposed to the sound stimuli.

The actual effect of noise on output and energy consumption of typists was measured in the Colgate laboratory from September, 1926, until March, 1927. Previous work by John J. B. Morgan, in the laboratories of Columbia University, had indicated that more effort was expended in simple typing under noise distractions than under quiet conditions.

In the Colgate experiments to be described, energy expenditure was measured by the collection and analysis of exhaled air. A gas mask was strapped to the subject's face and connected to adjoining rooms with a system of tubing. From the analyses the total calories expended were computed. The typist worked in a specially prepared test chamber, 15 feet by 6 feet, with a 9-foot ceiling. The room was lighted entirely with semi-indirect artificial light. The walls were of brick, covered with hard plaster.

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[1] *Journal of Industrial Hygiene,* October 1927, with permission of author and publisher.

[2] Laboratory technicians who assisted in gathering the data upon which this report is based are: Curtis Harford and Thomas Turino in charge; Ivan Sagal, H. P. Lange, James Hunter, Hilda Drexel, Paul W. Allen, and Joseph D. Farranto.

A "noise machine" was built to reproduce the sounds occurring in the usual busy office. This machine was electrically actuated and was placed on a ledge in one wall of the room. During all the experimental days to be reported the machine was in full blast, making sounds like an electric motor; ball bearings rotated in a hexagonal sheet iron drum; an auto siren and a telephone bell intermittently and automatically. When the walls of the test chamber were uncovered, the full effects of these noises were actually increased through reverberation. In half of the experimental days the sound intensity was reduced through the use of panels of acousti-celotex. From architects' specifications it is probable that these demountable panels reduced the heard sound in the room by about 50 per cent. This has been termed the *quieted phase* of the experiment. During the noisy phase the test chamber was no noisier than many offices.

Experienced typists were experimented upon. Three were of average skill, and one possessed phenomenal skill. The subjects were equally divided between the sexes.

Experimental Procedure

After a uniform breakfast the subjects were transported to the test chamber with a minimum of walking; the masks were attached, sealed with adhesive, and tested for leaks. Each subject then took his place in front of a noiseless typewriter, maintaining the position used when typing, but without actually typing. After half an hour in this position a sample of air was gathered in the Douglas bag. This was the air analyzed to ascertain the *resting energy expenditure.*

As soon as the resting air had been collected, the noise machine was started by closing an electric connection and the typist was instructed to begin work. Electric connections were used to record the time of starting and of finishing each letter, and the time required to take out a completed letter and to insert a new sheet of paper ready to resume writing. The typists worked at maximum speed, without pausing between letters. The same letter was written over and over again, about 2,000 copies being made in the course of the experiments.

Every fifteen minutes during the two-hour working period a sample of exhaled air was collected and analyzed to determine the calories being expended per minute.

The subjects were weighed in and out each morning. The resting periods started at 8 o'clock. In order to equalize for the subjects the process of getting used to the experimental conditions, the following order of noisy and quieted day was followed: first week, quieted; middle two weeks, full noise; last week, quieted.

The female subjects were not experimented with for four days before and after menstruation.

Experimental Findings

ENERGY CONSUMPTION

The average increase of the working metabolism over the resting metabolism was 52 per cent when the noise was deadened by the acousti-celotex panels, as contrasted with an average increase of 71 per cent when the noise was not quieted by the use of sound absorbing panels. This is a saving of 19 per cent of the energy consumption above the resting requirements which can be credited to the quieter condition. Or, expressed differently, there was 19 per cent more energy consumed by the typist when working under the noisy conditions.

It is somewhat difficult to say just what metabolic factors are at work causing the increased energy expenditure. Undoubtedly, however, there is dissipated energy. It is probable that even under the most favorable conditions more energy is expended than is really needed, and this margin of excess energy is apparently increased under the noisy conditions. The introspective observations of the experimental subjects would indicate that under the noisy conditions there is a general dissipation of this excess energy, the excess being spent not only in striking the keys harder but in a general tenseness of the entire musculature. A general heightening of muscular tonus throughout the whole body may be the principal cause of the 19 per cent increase in energy expenditure.

Speed of Work

There are two groups of records on speed of work: (1) time of typing a letter, or strokes per minute, and (2) time for removing a completed letter and inserting a new letter.

The average time for typing a letter under the noisy conditions was 162 seconds, as compared with 155 seconds when the noise was reduced approximately half by the absorbing panels. This represents an average gain in speed of 4.3 per cent when the noise is reduced.

Not all of the subjects were affected alike in speed. In energy expenditure increments they were remarkably uniform. Arranged in order of average typing speed we note the following:

Initials	Rank in Speed	Increase In Speed When Noise Was Reduced %
R.M.	slowest	0.0
H.B.	next slowest	0.8
P.F.	second fastest	3.6
H.K.	fastest	7.4

It appears that the speedier the worker is, the more adversely his output is affected by the distractions of noises.

In the time required to remove a completed letter and insert a fresh sheet of paper we find a range from 20 seconds for R.M. to 1.8 seconds for H.K. The subjects were affected somewhat differently, although on the average the paper was inserted a half second faster under the quieted conditions. The slowest typist, R.M., however, changed the paper more quickly under the noisy conditions. His introspections indicate that when the siren or the bell happened to sound as he was changing paper he was much quicker. All the other subjects were quicker in changing the paper under the quieted conditions, and all were slowed up especially by the siren or the bell, just the opposite of R.M. If we eliminate R.M. from the averages, we find that the papers were inserted a second and a half faster under the quieted conditions.

Errors Made

About 1,300 strokes were made for each letter. Errors were computed on the basis of wrong or incomplete strokes. These averaged about four per letter, although some typists consistently made ten or more such errors in each letter typed. The two slowest typists were slightly more accurate under the noisy conditions; the two fastest typists were slightly more accurate under the quieted conditions. These two tendencies exactly balance each other when an average is struck for the experimental squad.

Fatigue in Output

The average time required for the first five letters and that required for the last five letters written in each experimental period were compared in order to obtain a record of speeding up or slowing down during the noisy and quieted conditions.

Under the quieted conditions at the close of the two-hour period of work the average time per letter was seven seconds less than at the beginning of the period. With the noise machine unquieted by the absorbing panels the speed per letter at the close of the period was five seconds slower. All the subjects were similarly affected. Under noisy conditions there is no apparent "warming up," and each succeeding letter takes a little more time than the one before it; while under the quieted conditions a slight amount of speed is actually gained in each succeeding letter.

Fatigue in Energy Expenditure

An unexpected trend in the data was found in the calorie calculations made each fifteen minutes during the work period. It has been anticipated that with continued work under adverse conditions the energy expenditure might gradually increase. We were somewhat surprised to discover that the energy expenditure differences between the noisy and the quieted conditions were the same after the first fifteen minutes of work as they were after two hours of intensive work.

Summary of Findings

In many non-hospital cases the physician could apparently consider the working environment of the patient in cases of obscure neurasthenia and fatigue. The experiments on office conditions seem to indicate that in some instances a move to a quieter workplace may be as good as a rest, there being a difference of 19 per cent in the energy expenditure increment following working in a noisy as compared with a quieter environment. Men and women seemed to be similarly affected, while the more skilled typists were adversely affected in output to a greater extent than were the mediocre typists.

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By Donald A. Laird, Ph.D., Sci.D.

From a paper on this subject presented before the Acoustical Society of America, December 1929.

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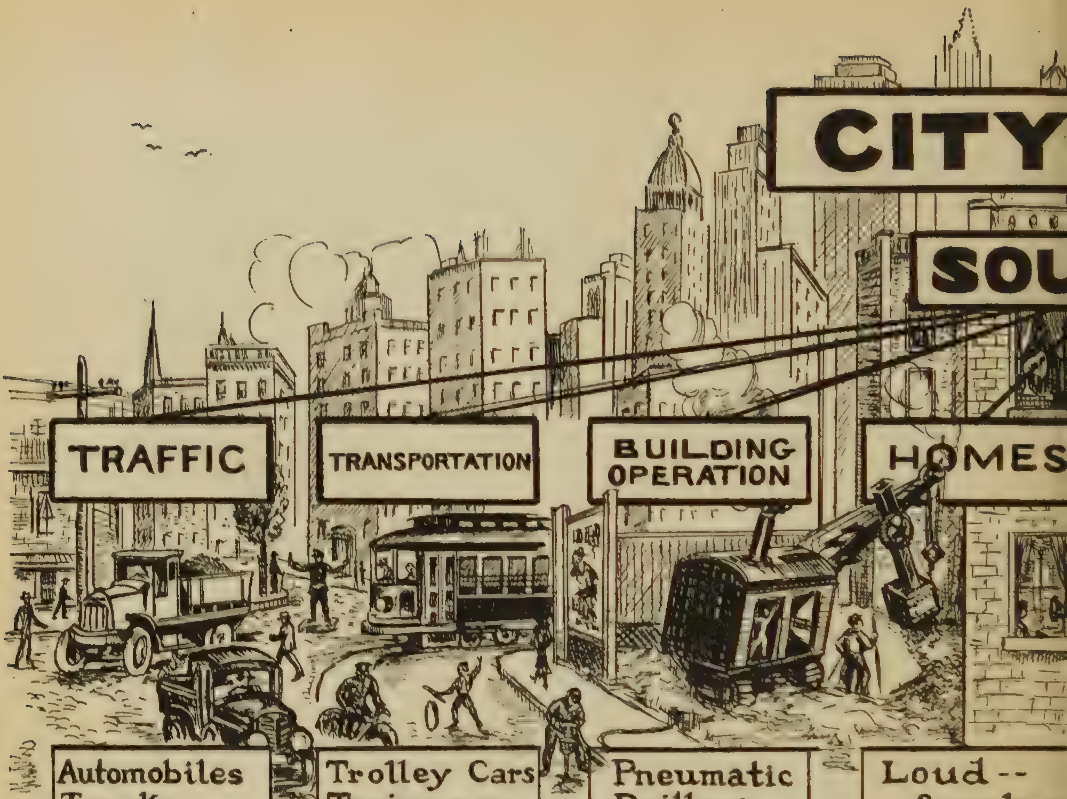

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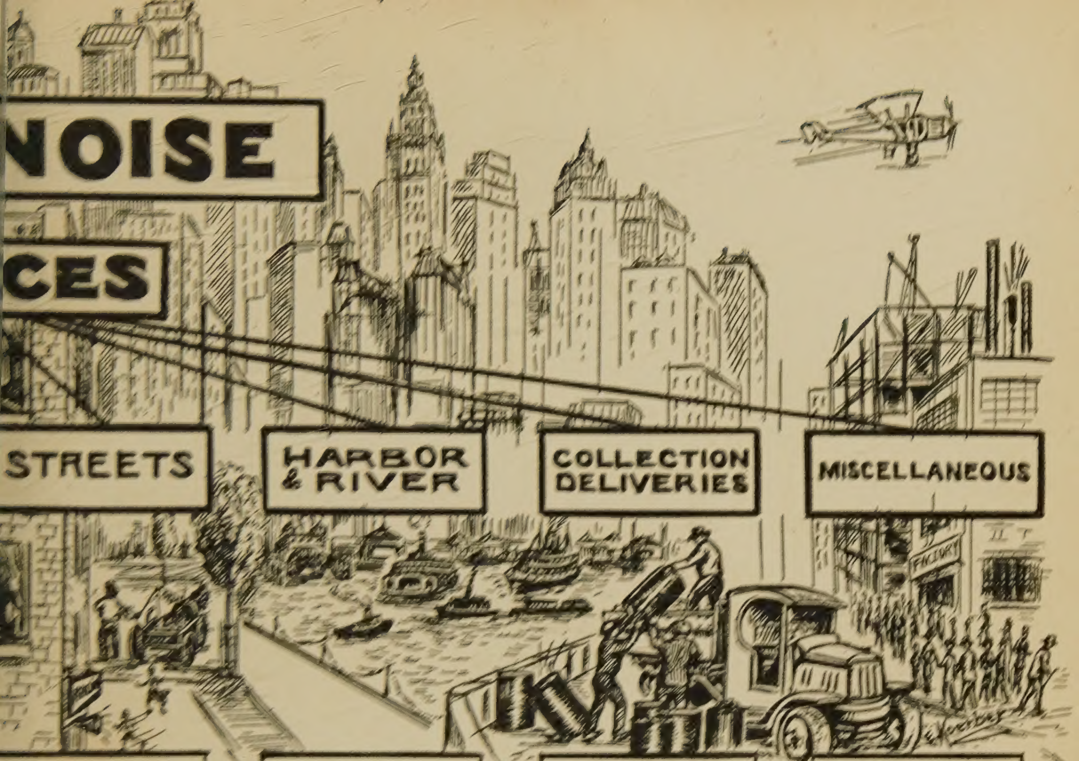

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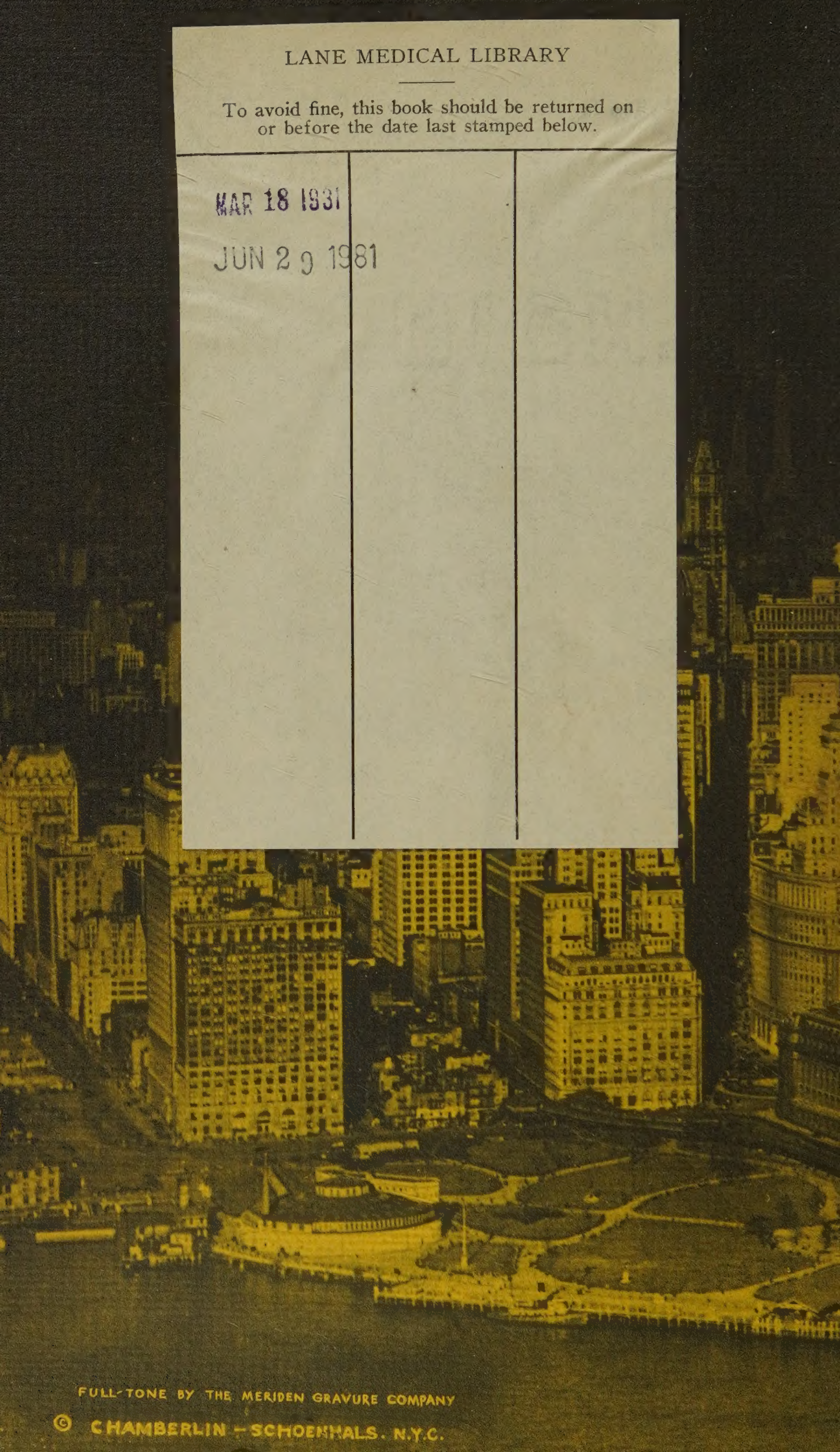

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